HISTORY OF WEATHER OBSERVATIONS
LOS ANGELES, CALIFORNIA
1847—1948

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ACKNOWLEDGEMENTS

There is a long list of people who contributed to the long record of climate in Los Angeles. The tireless and dedicated observers are the most important and the most direct contributors. Scores of other people contributed by having a sense of the historical importance of their documents and photographs and continuing to preserve them. Thanks to all who acted as archivists.

Todd Morris and Curt Kaplan of the National Weather Service Forecast Office in Oxnard, California provided valuable assistance. They were particularly helpful in locating and sharing photographs and textual materials from their office.

To those who will read this, thanks for continuing to be interested in the history of weather observations.

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INTRODUCTION

The turbulent times in California brought the United States Army to the Los Angeles area. An Assistant Surgeon accompanied the small force to provide medical care for the 121 soldiers in Kearny's Dragoons. On the morning of 5 June 1847, duty required Assistant Surgeon, Dr. John S. Griffin of that unit, to record the weather conditions at his post in El Pueblo de Los Angeles (Figure 1).

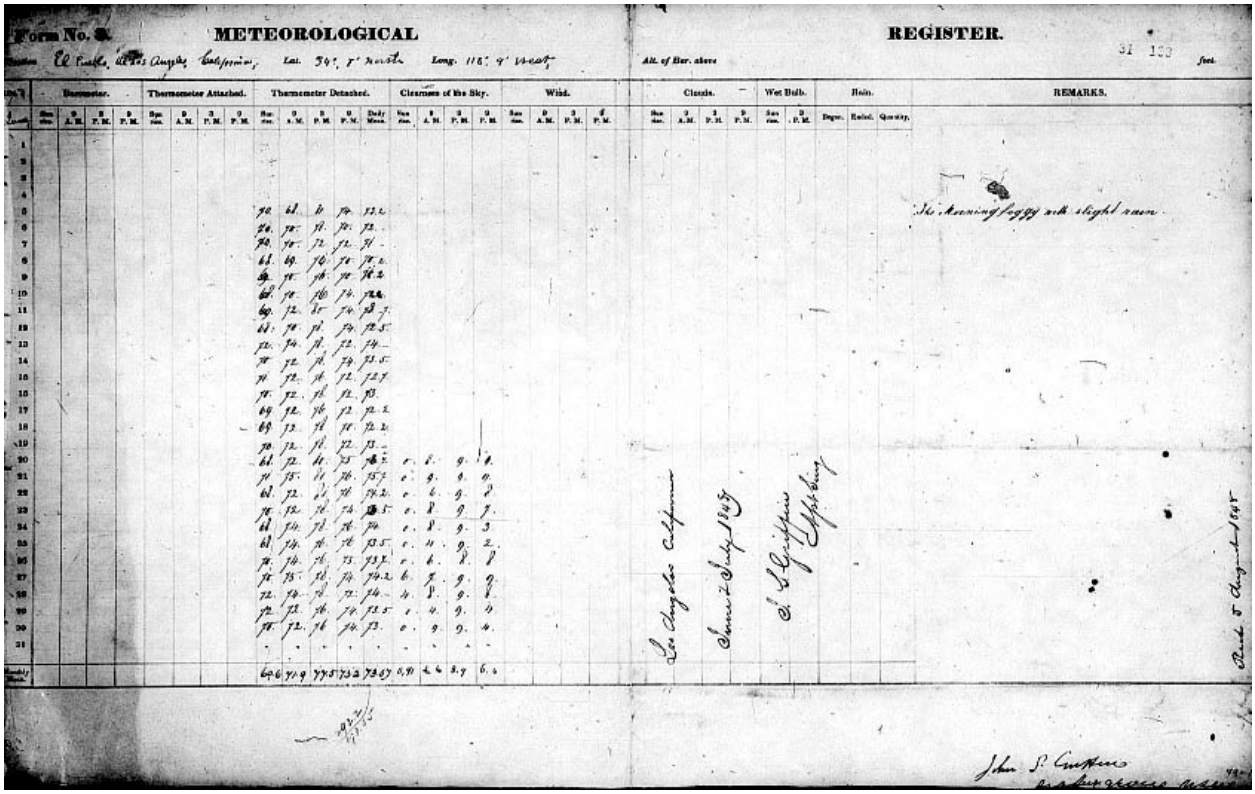


Figure 1. First Weather Observations from Los Angeles, June 1847
Source: National Climatic Data Center

On 20 June 1847, he began recording the "clearness of the sky" and in July he recorded rainfall when it occurred.

Notice that written along the right margin of the form was the notation, "Rec'd 5 August 1848." All of the observation forms from June 1847 through March 1848 were received in Washington on that date, apparently all were submitted after the Dragoons moved to San Diego.

So began the first official weather observations in Los Angeles. From our vantage point one hundred sixty-nine years later, we are astounded by the survival of that record. Equally astounding is the succession of improvements in meteorology that have occurred between that first observation and the forecasts now being generated by the modern National Weather Service Forecast Office for the Los Angeles area.

The Record

In 1814 during the War of 1812, the Surgeon-General of the Army was James Tilton M.D. He issued a directive to his Army hospital, post, and regimental surgeons to record the weather. Although this beginning was encouraging it was dropped between 1815 and 1817. The effort to collect climate data was renewed by his successor, Joseph Lovell, M.D. in 1818. He ordered each Army surgeon to ".... keep a diary of the weather...." and to note ".... everything of importance relating to the medical topography of his station, the climate, diseases prevalent in the vicinity...." The emphasis was on subjective observations and, at least in effect, data were collected to supplement the observer's remarks.

The motivation for the new task was to determine if there was a cause and effect relationship between climate and the health of the soldiers. Dr. Lovell said the purpose was to ascertain if "in a series of years there be any material change in the climate of a given district of the country; and if so, how far it depends on cultivation of the soil, density of population, etc." Now, nearly two hundred years later, that could still serve as a mission statement.

The medical doctors in the Army were a logical choice to perform these early observations. If there was a connection between climate and disease, they were most likely to find it. They were trained scientists, schooled in the importance of careful observations and reasoned analysis. They were responsible people who could be trusted in this task just as they were in other medical tasks. They fulfilled their obligations as evidenced by the fact that the entries of the observations and the signature of the surgeons were in the same handwriting.

The Army was a logical choice of an organization to assume the climatic data collection. It had the ability to direct action and assure compliance. It had the capacity to collect data in a single standardized format so that geographical differences would be assessed. It had the advantage of having a presence even in the most remote areas of the frontier especially in areas that had few or no cities. That was important because some

knowledge could be obtained before large numbers of people migrated into the frontier areas.

Dr. John S. Griffin was making weather observations on the westernmost frontier at an historic time less than five months after the Treaty of Cahuenga, almost two years before California officially became a territory of the United States, and about three years before California became a state,

Goal of the Study

The goal of this study was to document the weather observational history of Los Angeles, California. The climatic data, and information from the observations made there, are readily available for the entire period of record. They may be accessed through the National Climatic Data Center, the Western Regional Climate Center, and the State Climatologist of California. The challenge of this study was to identify the Los Angeles role in the development of a federal weather observational program and where it fit in the route that followed from the California observers' first efforts through the Signal Service Observer Sergeants and the Weather Bureau meteorologists, to the current National Weather Service Forecasters and their extensive observational and forecast network of today.

LOCATION OF OBSERVATIONS

A major change of location philosophy occurred when the Signal Service became the primary national weather observation network. Where possible, the Smithsonian's and Surgeon General's temperature observations were made at eye level over sod and the precipitation measurements were made with rain gauges mounted at or just above the ground. The first observations in 1847-1848 sent to the Surgeon General's office from Los Angeles were made at ground level.

The Signal Service assumed the observation role in Los Angeles in 1877. Its emphasis was on the availability of the telegraph to transmit near real time data to Washington where daily weather maps were prepared. The telegraph lines followed railroad tracks and the telegraph offices were located in downtown locations. The result was that the Signal Service observation sites were downtown on rooftops, preferably the tallest building in town.

The Weather Bureau replaced the Signal Service but retained their site philosophy. There Station Regulations of 1905 had instructions for choosing locations.

> In selecting he building in which to establish a Weather Bureau office, special considerations should be given the instrumental exposure, the terms offered, and the accessibility of the structure.
>
> In general, the office building should be the higher than the surrounding structures, preferably with a flat or gently sloping roof, without towers, gables or high chimneys, and should afford facilities for the exposure of the instruments as provided in the circulars of the Instrument Division.

The result of this philosophy was that the rooftops of downtown buildings were the observation sites from 1877 until the moves to airports around 1950.

The rooftop temperature and precipitation measurements caused some consternation in Los Angeles. The Los Angeles Times in an article on 31 January 1892 discussed the disparity between the Signal Service's data and those collected by three other observers in Los Angeles; Mr. Ducommun, Mr. Germain, and the Southern Pacific Railway observer.

In seasonal precipitation, Ducommun had accumulated 4.27 inches while the Signal Service recorded only 2.89 inches. The articles stated, "It represents a uniform and almost unvarying tendency of the Signal Service to underrate our rainfall." All the observers used standard pluviometers, it said. The only difference was that "While the Government's is located on the top of a four-story building the others are placed on or near the surface of the ground." There followed a discussion of the trajectory of falling

raindrops stating that the trajectory above the rooftop is decidedly more angular and therefore the catch was reduced.

In temperature, a similar disparity existed. A table was presented with daily maximum and minimum temperatures for December 1891. The absolute minimum was 33˚ on 7 and 25 December—no freezing temperatures during the month. The contrary evidence was from the vegetable gardens, flowers such as calla lilies, bananas, and leaves on trees that suffered from frost. Temperatures at the surface were reported to be as low as 22˚ with ice forming to 3/8th of an inch thick. There was a discussion of the lapse rate and this suggestion.

> The best thing the Signal Service observer can do, if he wishes, to secure consistency in his reports, is to come down off his perch in that four-story building. We can stand the exact truth about our weather and this is what everybody wants.

The complaints seem to have had at least one effect. The 1903 Climatology of California had a section on Los Angeles written by the Weather Bureau Official in Charge there. The caveat included in its final paragraph had a familiar ring.

> In consulting the accompanying temperature tables it should be borne in mind that the instruments from which the data were obtained were located on roofs of buildings, 60 to 70 feet above ground, exposed in standard shelters and above the stratum of colder air which settles on low ground. The temperature so obtained is appreciably different from that on the surface, lower maxima and higher minima resulting. For the above reasons the temperature seldom falls to freezing or below at the Weather Bureau station, while in the low grounds it frequently reaches 32° or several degrees below in winter, when a much higher temperature obtains at the station; this corresponds to the foothill belts, where frost seldom if ever happens. Frost occurs in the low sections of the city when in the hill portions there is not the least trace, and where delicate flowers, such as calla lilies may be seen in full flower.

The station moved several time during the next fifty years (Figure 2) but never away from a rooftop.

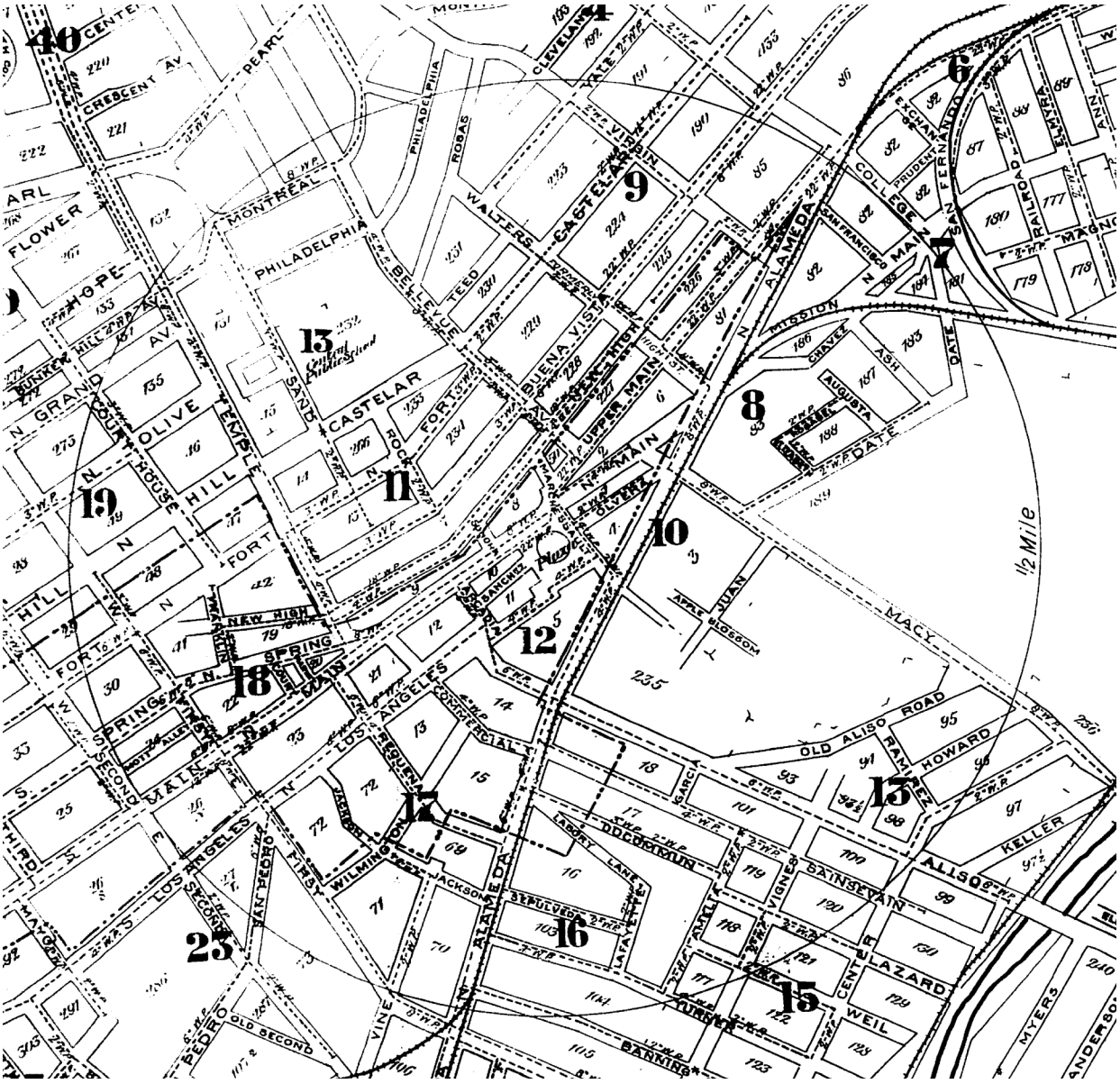


Figure 2. Downtown Los Angeles, 1888
Source: Sanborn Map & Publishing Company

Latitude, Longitude, and Elevation

Latitude and Longitude

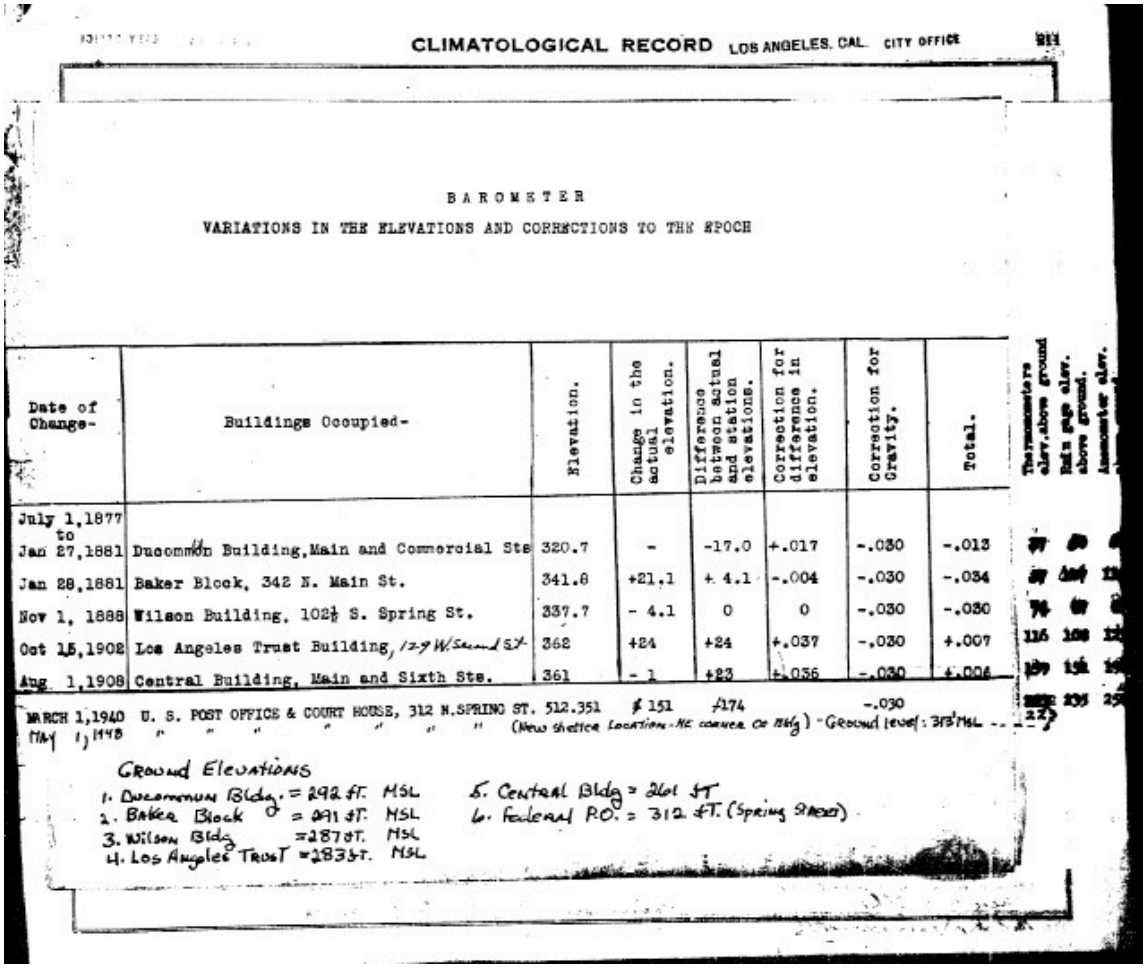
The first observer recorded what he believed to be the latitude and longitude of his observation site. That site was at the El Pueblo De Los Angeles, the coordinates indicate elsewhere. All the others listed in Table 1 were taken from the Station History Form 500-1 prepared in 1962.

Table 1
Latitude and Longitude of Station Locations

Period	Latitude	Longitude
Jun 1847— Mar 1848	34˚ 07’ N*	118˚ 07’ W*
Jul 1877 — Jan 1881	34˚ 03.4’ N	118˚ 14.3’ W
Jan 1881 — Oct 1888	34˚ 03.3’ N	118˚ 14.3’ W
Nov 1888 — Oct 1902	34˚ 03.1’ N	118˚ 14.5’ W
Oct 1902 — Jul 1908	34˚ 03.0’ N	118˚ 14.6’ W
Aug 1908 — Feb 1940	34˚ 02.8’ N	118˚ 14.9’ W
Mar 1940 ————	34˚ 03.4’ N	118˚ 14.3’ W

*The actual coordinates can be estimated at about 34˚ 4’ N and 118˚ 14’ W

Barometer Elevations



CLIMATOLOGICAL RECORD LOS ANGELES, CAL. CITY OFFICE

BAROMETER

VARIATIONS IN THE ELEVATIONS AND CORRECTIONS TO THE EPOCH

Date of Change-	Buildings Occupied-	Elevation.	Change in the actual elevation.	Difference between actual and station elevations.	Correction for difference in elevation.	Correction for Gravity.	Total.
July 1,1877 to Jan 27,1881	Ducommun Building, Main and Commercial Sts	320.7	-	-17.0	+.017	-.030	-.013
Jan 28,1881	Baker Block, 342 N. Main St.	341.8	+21.1	+ 4.1	-.004	-.030	-.034
Nov 1, 1888	Wilson Building, 102½ S. Spring St.	337.7	- 4.1	0	0	-.030	-.030
Oct 15,1902	Los Angeles Trust Building, 129 W. Second St.	362	+24	+24	+.037	-.030	+.007
Aug 1,1908	Central Building, Main and Sixth Sts.	361	- 1	+23	+.036	-.030	+.006
MARCH 1,1940	U. S. POST OFFICE & COURT HOUSE, 312 N. SPRING ST.	312.351	-151	-174		-.030	

(New station location - NE corner of bldg.) - Ground level: 315' MSL

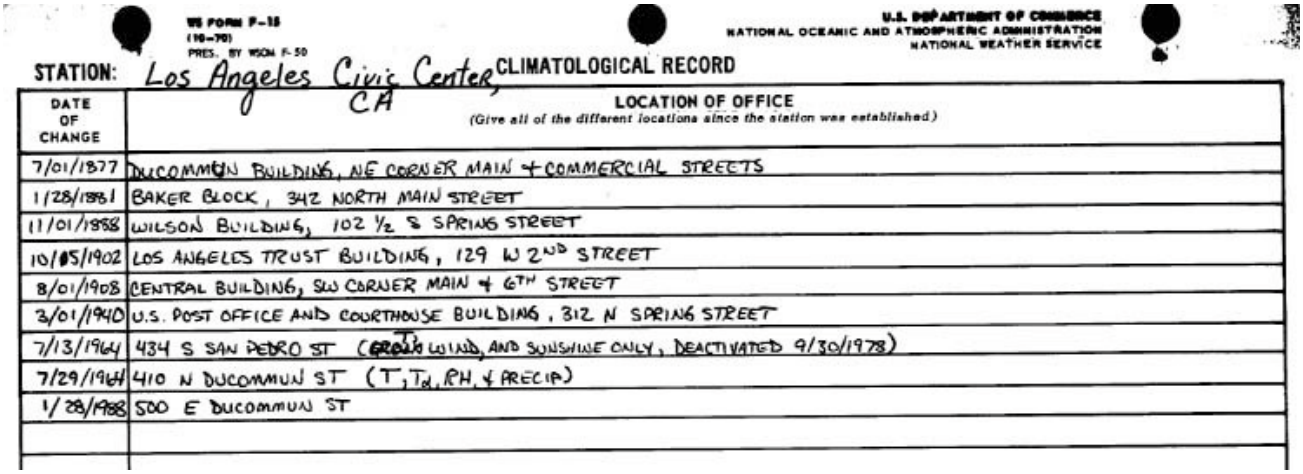
Ground Elevations

1. Ducommun Bldg. = 292 ft. MSL
2. Baker Block = 291 ft. MSL
3. Wilson Bldg = 287 ft. MSL
4. Los Angeles Trust = 283 ft. MSL
5. Central Bldg = 261 ft
6. Federal P.O. = 312 ft. (Spring Street)

Figure 3. Barometer Elevations from 1877
Source: National Weather Service Forecast Office, Los Angeles

Street Addresses

The Climatological Record at Los Angeles (Figure 4) lists the street addresses of the observation sites beginning with the Signal Service in 1877.



WS FORM F-15 (10-70) PRES. BY WSOM F-50

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

STATION: Los Angeles Civic Center, CA

CLIMATOLOGICAL RECORD

DATE OF CHANGE	LOCATION OF OFFICE (Give all of the different locations since the station was established.)
7/01/1877	DUCOMMUN BUILDING, NE CORNER MAIN + COMMERCIAL STREETS
1/28/1881	BAKER BLOCK, 342 NORTH MAIN STREET
11/01/1888	WILSON BUILDING, 102 ½ S SPRING STREET
10/15/1902	LOS ANGELES TRUST BUILDING, 129 W 2ND STREET
8/01/1908	CENTRAL BUILDING, SW CORNER MAIN + 6TH STREET
3/01/1940	U.S. POST OFFICE AND COURTHOUSE BUILDING, 312 N SPRING STREET
7/13/1964	434 S SAN PEDRO ST (T, WIND, AND SUNSHINE ONLY, DEACTIVATED 9/30/1978)
7/29/1964	410 N DUCOMMUN ST (T, T_d, RH, + PRECIP)
1/28/1988	500 E DUCOMMUN ST

Figure 4. Street Addresses of Observation Locations After 1877
Source: National Weather Service Forecast Office, Los Angeles

Observation Sites

Surgeon General Observation Site

Jun 1847-Mar 1848, El Pueblo de Los Angeles

El Pueblo de Los Angeles was the first observation site. General Kearny's First Dragoons with his guide Kit Carson and his surgeon John S. Griffin occupied the site. The specific site would have been near Dr. Griffin's hospital. No image of that facility could be located.

Signal Service Observation Sites

Jul 1877-Jan 1881 Ducommun Building, Main and Commercial Streets

The Signal Service opened its first office in Los Angeles in the Ducommun Building. It was a brick structure (Figure 5) located at the northeast corner of Main and Commercial Streets. The Signal Service Office was on the third floor and faced Main Street.

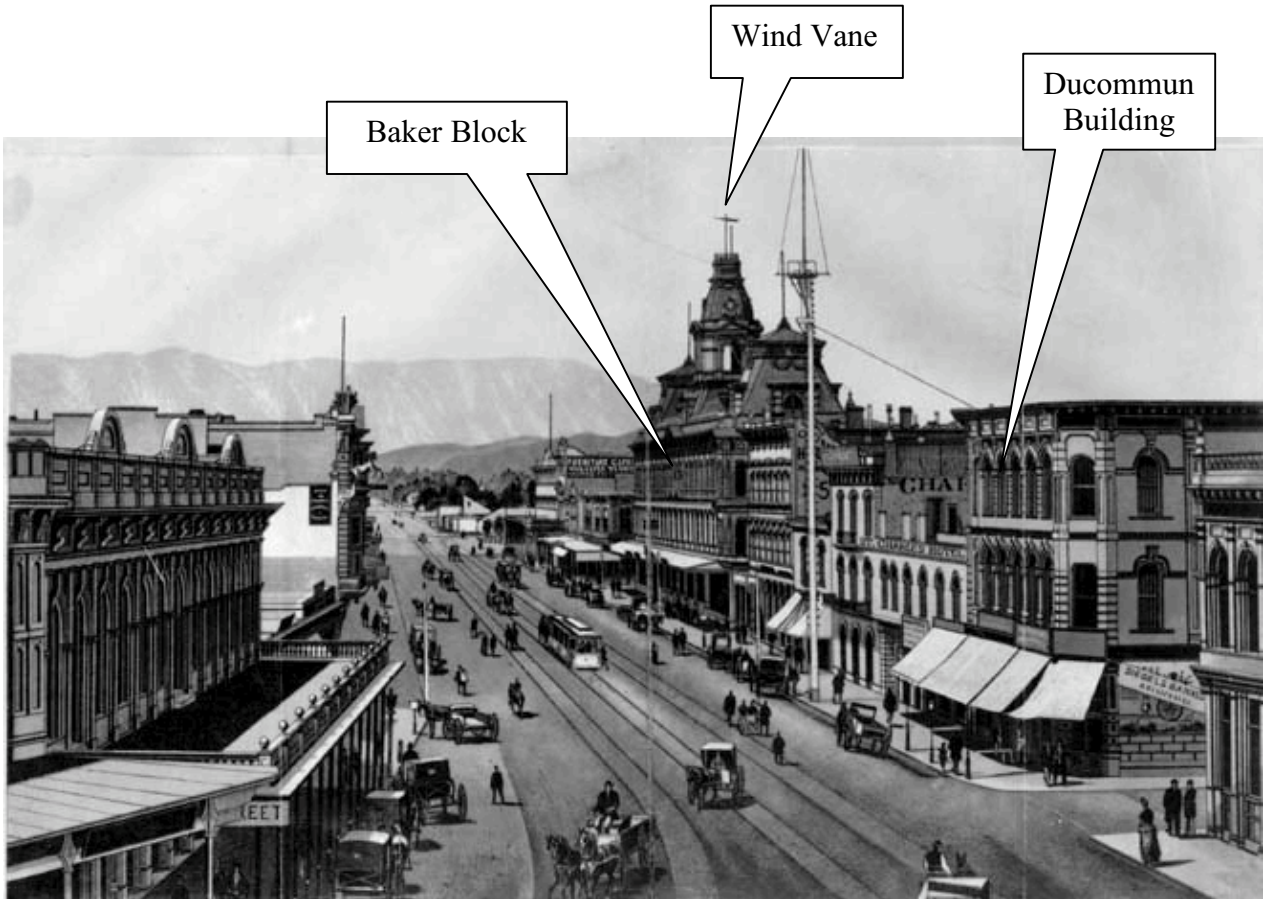


Figure 5. Looking North on Main Street about 1885
Source: Los Angeles Public Library, http://jpg2.lapl.org/pics08/00013979.jpg

The office was reported to be in a good location in the business district, within a block of the telegraph office and within two blocks of the post office. The first Signal Service Inspection Report was made 20-21 November 1878. Inspection reports were required to include a drawing of the layout of the office. It is fortunate that these drawings were required. They showed the locations of the instruments that were located inside of the office. They showed the location of the window shelter that housed the thermometers and hygrometers and indicated the direction of north. The adjacent street was labeled. Even the location of the stove was shown, valuable now to evaluate the mercury barometer and its attached thermometer.

The office layout diagram that was drawn by Lieutenant Robert Craig who inspected the Office in 1878 is shown in Figure 6.

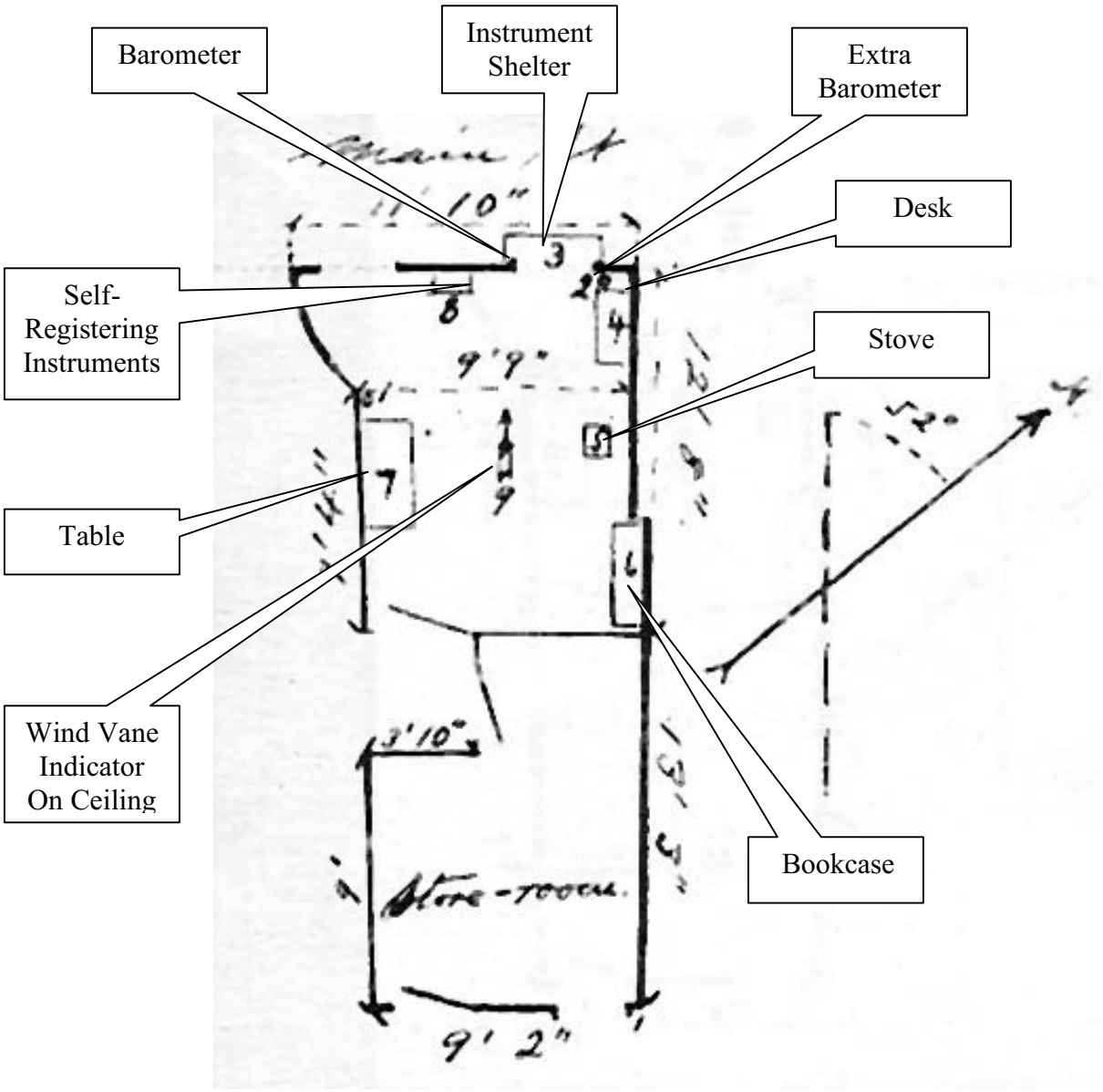


Figure 6. Office Layout Ducommun Building 1878
Source: National Archives and Records Administration

The Inspector reported that the location of the office was good, near the business portion of town, within one block of the telegraph office. He noted that there were hills to the north and northwest that might have an effect on the measurement of wind direction and velocity.

Jan 1881-Oct 1888 Baker Block, 342 North Main Street

The second Signal Service location was in the Baker Block at the corner of Main and Arcadia Streets, with an address of 342 North Main Street. The building was said to be the finest in the City. It was located in the central tower (Figure 7). Note the location of the telegraph office on the first floor, another necessity in site location.

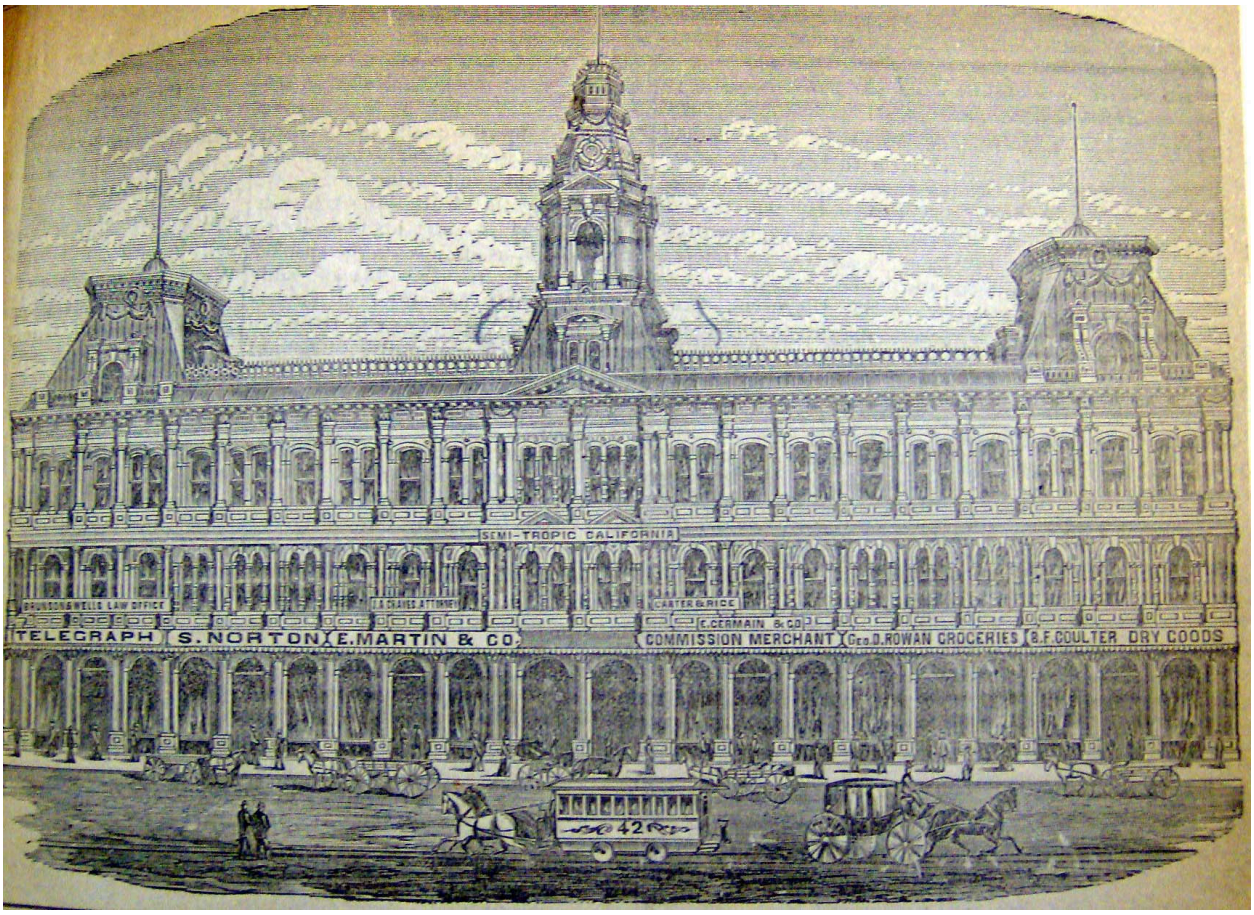


Figure 7. Baker Block 1880
Source: National Archives and Records Administration

The instrument shelter was located on the north side of the building, the preferred location to have the least amount of direct sunlight. The barometer was located on the east side of the room, near a window.

Because the office was located in the central tower, it had a peculiar shape. Even so, the building was one of the most elegant buildings in the City at that time.

Its layout as depicted by the Inspector in 1880 is shown in Figure 8.

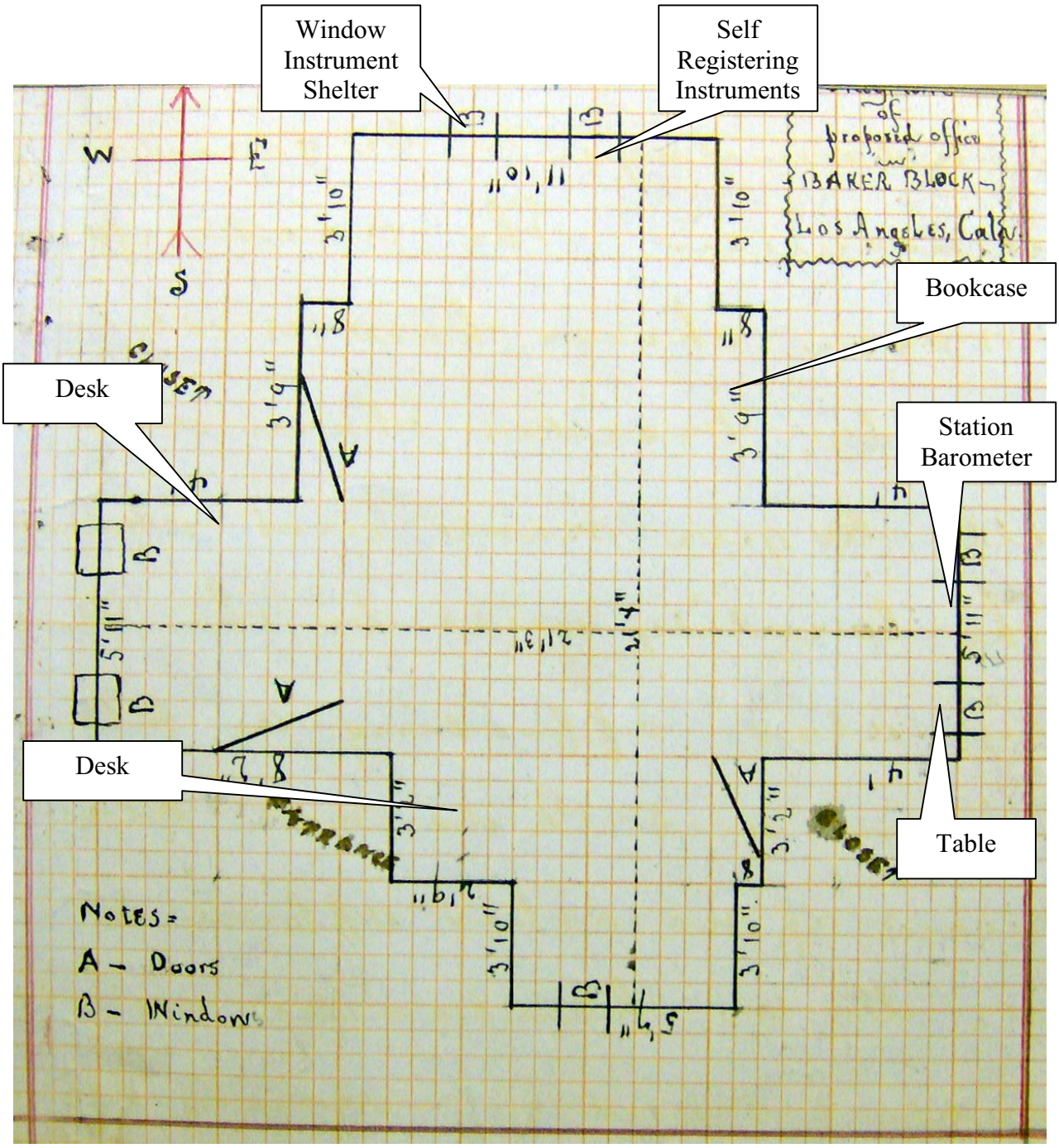


Figure 8, Office Layout 1880, Baker Building
Source: National Archives and Records Administration

Nov 1888-Oct 1902, Wilson Building, 102 ½ S. Spring St

The Signal Service Office was moved to the Wilson Building (Figure 9) in November 1888. The building was located at the southeast corner of 1st and Spring Streets. The office was located on the 4th Floor (the top floor) in Rooms 304-305, and 322. The Inspector called it the "New Wilson Building". He recommended that they find a new building but or until the new Federal Building was built less than two years into the future.

Figure 9. Wilson Building 1890
Source: Los Angeles Public Library, http://jpg2.lapl.org/pics18/00018908.jpg

Oct 1902- Jul 1908, Los Angeles Trust Building, 129 W. 2nd St

Apparently, the decision was not to wait because they moved to the Los Angeles Trust Building in October 1902. The Inspection Report of October 1903 identified the office as located in three rooms on the sixth floor of the eight-story "Trust Building." It

was said to be located at the corner of 2nd and Spring Streets. That location and description fits the building shown in Figure 10. That photograph has the building identified as the Bryson-Bonebrake Building on the northwest corner of 2nd and Spring Streets in 1889. Other photographs of the period show no other eight-story building at that intersection.

Figure 10. Probable Location of the Signal Service 1902-1908
Source: Los Angeles Public Library, 1889 photo
http://jpg2.lapl.org/pics19/00019230.jpg

Aug 1908-Feb 1941, Central Building, Main and 6th Street

The Weather Bureau in Los Angeles moved on 1 August 1908. It was occupied eighth floor offices of the Central Building (Figure 11) that stood on the southwest corner of Main and 6th Street. The instruments were located on the roof with "first class exposure" according to inspection reports.

Figure 11. Central Building, Southwest Corner Main and 6th Street
Source: National Weather Service Forecast Office, Oxnard

The office (Figure 12) was in rooms 830, 831, 832, 833, and 834. It also used the 10 X 12 foot space in the "Pent House" for battery and storage purposes and the roof for the rain gauge and wind instruments.

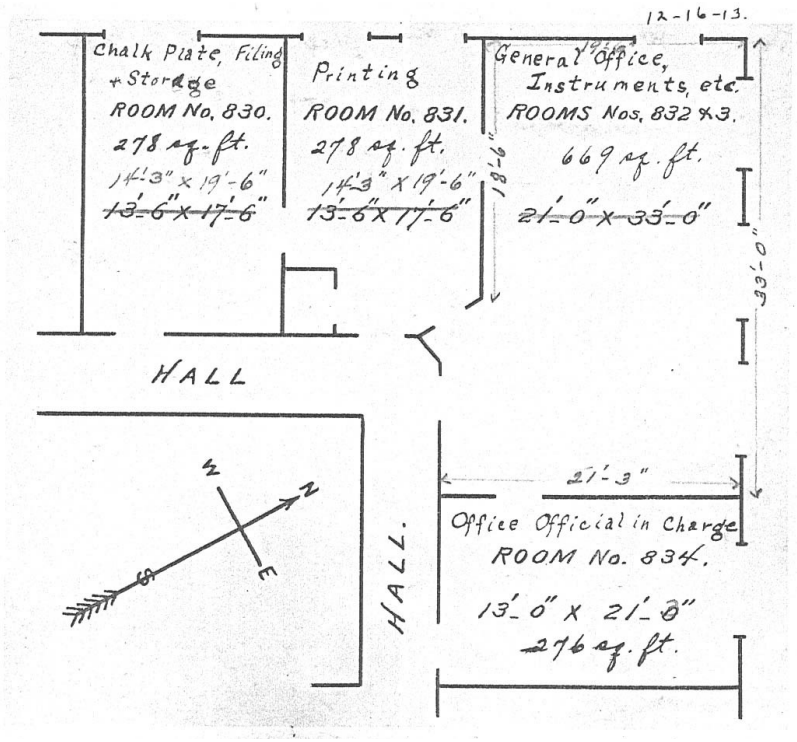


Figure 12. Floor Plan of Forecast Office 16 December 1913
Source: National Weather Service Forecast Office, Oxnard

Mar 1940 – End of this Study Period 1948, Federal Building, 312 North Spring St

The new Federal Building (Figure 13) recommended as a location several years before became the home to the Weather Bureau Office in March 1940. It remained there through the end of the period of this study.

Figure 13. Post Office and Court House Building, 1951
Source: Los Angeles Public Library, http://jpg2.lapl.org/pics19/00019011.jpg

Environment

The earliest observations were made in a small town setting of Los Angeles, a city that would not be incorporated until three years later. The hills in the northern and northwestern portion of town were thought to influence wind direction and velocity. One hill was about 75 feet above the top the office building but the proximity to the telegraph and post offices would be compromised by a move to them.

Los Angeles had become a city by the time it was described in McGroarty's book in 1874 by three of the City's physicians.

> By those who, from their extended knowledge acquired both by study and practical experience in travel, are best qualified to judge the climate of Southern California is pronounced the best in the world and alike beneficial to those in health, the invalid and those liable to become victims of hereditary diseases….
>
> The key of this climate lies in this, that it has a warm sun and cool air; hence the cool nights. One picks ripening figs and bananas grown in his own dooryard, and then goes to sleep under a blanket….

The population of Los Angeles County grew rapidly from 3,530 in 1850 to 10,550 in 1860; reached 101,454 in 1890, 504,131 in 1910, and 2,208,492 in 1930; and passed four million in 1949. That urbanization resulted in dramatic changes in its climate, particularly the higher temperature that are recorded near the center of large cities. Nevertheless, the higher temperatures recorded were likely representative of the urban ambient temperatures.

INSTRUMENTATION

The instruments used throughout the Signal Service observation period have a good record. The Climatological Record Book from the National Weather Service Office in Los Angeles was used to document instrument numbers.

Thermometer

The Chief Signal Officer's Annual Report for 1879 gave instructions for using the thermometer.

> The thermometer should be hung in the instrument-shelter[1] in such a position that it will always be at least one foot from the windowpanes or the wall of the buildings to which it is attached. The instrument must be hung vertically, with the middle of the scale at a height that will bring it on a level with the eye of the observer. The readings should be made at all time, but especially in the winter, through the panes of glass without raising the sash, when the shelter is built out from a window. When the shelter is built upon the roof, great care must be exercised in making the readings, in order to prevent the instrument from being affected by the heat of the body or the lantern at night. The observations must be made a rapidly as is consistent with accuracy.

The thermometers were to be tested three times each year using the procedures outlined in the 1879 report.

> Place the thermometer to be tested in the vessel provided for this purpose, keep them in a vertical position, pack finely pounded ice around them to a height a little above the freezing point, and let them remain for one hour, at the expiration of which time read off the height of the mercury, without removing them from the ice, note the result of the test of each thermometer in the daily journal, and report it to this Office in the journal abstract.

If instrumental errors were found and reported and if corrections were necessary, they would be authorized by the Chief Signal Service's Office.

The self-registering thermometer was one of the innovations in meteorological observations. It was two J-shaped thermometers each with small wires embedded that acted as index markers for the highest and lowest temperatures since the instrument was

[1] The reference was to a window shelter

reset. These markers moved as the mercury expanded with warming or contracted with cooling and were left in place at their most extreme position. Loomis described a self-registering thermometer (Figure 14) in his Treatise on Meteorology in 1868.

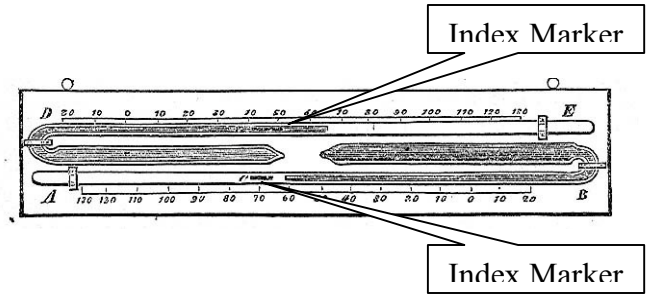


Figure 14. Self-Registering Thermometer
Source: Loomis' Treatise on Meteorology, 1868

The first observations of temperature in 1847 and 1848 were made at eye level above the ground. All subsequent observations were made from 37 feet to 159 feet about ground.

Instructions for the maximum thermometer were included in the 1879 report. It cautioned against breakage when spinning it to reset the marker. Table 2 shows the maximum thermometers used in Los Angeles as recorded in that station's Climate Record Book. Broken instruments are indicated by *, inaccurate instruments by ** and that convention is used throughout the other tables.

Table 2. Maximum Thermometers Used at Los Angeles

	In Use	
Number	**From**	**To**
311	1 Jul 1887	Aug 1884
77	20 Feb 1884	20 Feb 1888
1850	20 Feb 1885	31 Jul 1891
2648	31 Jul 1891	7 Feb 1895
4079	7 Feb 1895	16 May 1898
4766	16 May 1898	29 Mar 1903
*7834	29 Mar 1903	23 Apr 1902
8259	23 Apr 1902	24 Feb 1904
*9088	24 Feb 1904	16 Feb 1909
*8258	16 Feb 1909	Apr 1915
*4817	Apr 1915	18 Mar 1919
*13659	18 Mar 1919	18 Mar 1919
*4817	18 Mar 1919	18 May 1919
18492	18 May 1919	?
**48189	17 Feb 1942	17 Aug 1942
48194	17 Aug 1942	

The 1879 instructions cautioned against overheating the spirits when trying to reunite the column when it became separated.

Table 3. Minimum Thermometers Used at Los Angeles

	In Use	
Number	**From**	**To**
260	1 Jul 1877	Aug 1884
964	Aug 1884	20 Feb 1888
1674	20 Feb 1888	31 Jul 1891
2499	31 Jul 1891	22 Aug 1891
*1855	22 Aug 1891	27 Sep 1891
2602	27 Sep 1891	18 Mar 1895
2690	18 Mar 1895	12 Oct 1896
3804	12 Oct 1896	16 Aug 1898
4257	16 Aug 1898	?
5574	?	8 May 1901
5712	8 May 1901	23 Apr 1903
6077	23 Apr 1903	24 Feb 1904
*6764	24 Feb 1904	19 Aug 1918
6077	19 Aug 1918	19 May 1919
14699	19 May 1919	21 Jan 1925
17037	21 Jan 1925	8 Jan 1934
20095	8 Jan 1934	

Dry thermometer number 425 was the first one used and it was mounted at 36’ 06” AGL in the window shelter.

Table 4. Dry Thermometers Used at Los Angeles

	In Use	
Number	**From**	**To**
425	1 Jul 1877	Aug 1884
*1321	Aug 1884	30 Sep 1885
270	30 Sep 1885	2 Dec 1885
1596	2 Dec 1885	20 Feb 1888
3585	20 Feb 1888	31 Jul 1891
*3364	31 Jul 1891	29 Aug 1897
3924	29 Aug 1897	8 May 1901
3951	8 May 1901	29 Mar 1902
2783	29 Mar 1902	16 May 1902
*3948	16 May 1902	27 Jan 1903
4620	27 Jan 1903	5 Jun 1902
2783	5 Jun 1902	?
5037	29 Oct 1919	7 Aug 1938
18066	7 Aug 1938	

The 1879 Annual Report described the proper technique in reading the wet bulb thermometer of the hygrometer.

> When the temperature of the air is below the freezing point, the water will be emptied from the cistern, and in making an observation the wet bulb will be moistened with cold water, and the instant the mercury has reached its minimum, its height will be noted. *Alcohol must not be used.*

Table 5. Wet Thermometers Used at Los Angeles

	In Use	
Number	**From**	**To**
732	1 Jul 1877	Aug 1884
1310	Aug 1884	12 Mar 1888
2497	12 Mar 1888	31 Jul 1891
*3399	31 Jul 1891	13 Aug 1897
3365	13 Aug 1897	5 May 1900
3750	5 May 1900	29 Mar 1902
*2306	29 Mar 1902	3 Apr 1902
3750	3 Apr 1902	6 May 1902
*3503	6 May 1902	15 Nov 1905
*4708	15 Nov 1905	22 Mar 1910
4670	22 Mar 1910	5 May 1938
5929	5 May 1938	?
*18133		5 Dec 1941
20877	5 Dec 1941	?

Barometer

Each station was equipped with two mercury barometers. Twice each month, ten comparative readings on each of those two days would be made and recorded in the daily journal. Those reading were to exclude elevation corrections, correcting for temperature and instrument error only. The comparison would indicate if there was a variance.

The barometer had a thermometer attached. Loomis described the purpose in his Treatise on Meteorology.

> Heat expands the column of mercury; that is, diminishes its specific gravity, and thus a greater height is required to produce a given pressure. Now, since the barometer is daily subjected to changes of temperature, variations in the height of the column do not necessarily indicate variations of pressure. Before we can decide whether there has been a change of pressure, we must compute the effect due to the change of temperature. For this purpose, we must know the

temperature of the mercury at each observation; and, accordingly, a thermometer always accompanies a barometer, and is technically called the attached thermometer. At every observation of the barometer the attached thermometer should also be observed. For the purpose of comparison, all barometric observations should be reduced to a standard temperature, and the temperature generally agreed upon is that of melting ice. The expansion of mercury from the temperature of melting ice to that of boiling water is 1/55 of its volume, which is about 1/10,000th part for one degree of Fahrenheit's thermometer. In order, therefore, to reduce the observed height of the barometer to the height which would have been indicated if its temperature had been 32°, we must subtract the ten thousandth part of the observed altitude for each degree above the freezing point. If the temperature be below 32°, this correction must be added to the observed altitude. Tables have been computed, from which we may obtain, by mere inspection, the correction to be applied to the observed height of the barometer.

Table 6. Barometers Used at Los Angeles

	In Use	
Number	**From**	**To**
192	1 Jul 1877	?

Anemometer

The weather vane had to be mounted with care to compensate for magnetic variation. That variation in Los Angeles was 14˚ east of true north. Instructions were provided to align the vane using a magnetic compass.

The Station History, Weather Bureau Form 500-1, prepared in 1962 stated that the exposure from July 1877 through October 1888 was “in the lee of a hill that decreased velocities from SW thru NNW quadrants.”

In 1887, the Inspector noted that it would be impossible to find a better exposure for the wind instruments. The tower on which they were mounted was the highest point in the City.

Figure 15 shows the wind vane on the roof of the Central Building in 1940.

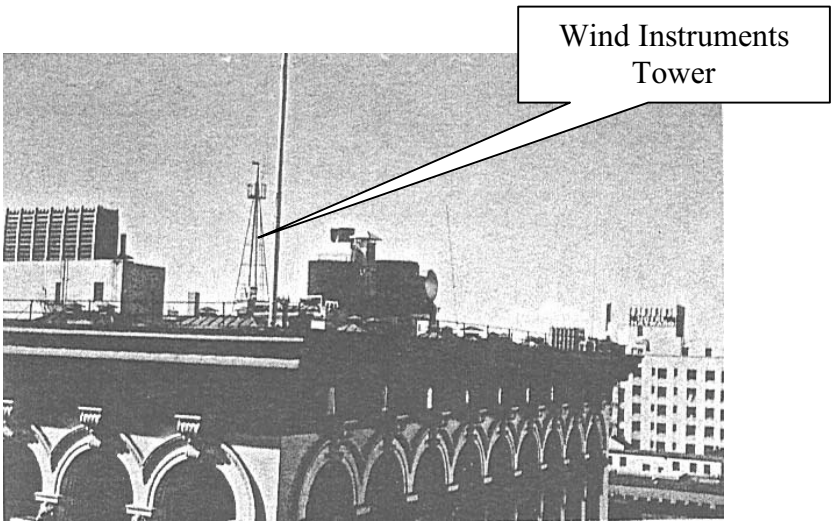


Figure 15. Wind Instruments Tower, Central Building, 1940
Source: National Weather Service Forecast Office, Oxnard

After March 1940, the Station History form noted increased wind velocities because the anemometer was mounted about 20 stories above ground. That installation is shown in Figure 16.

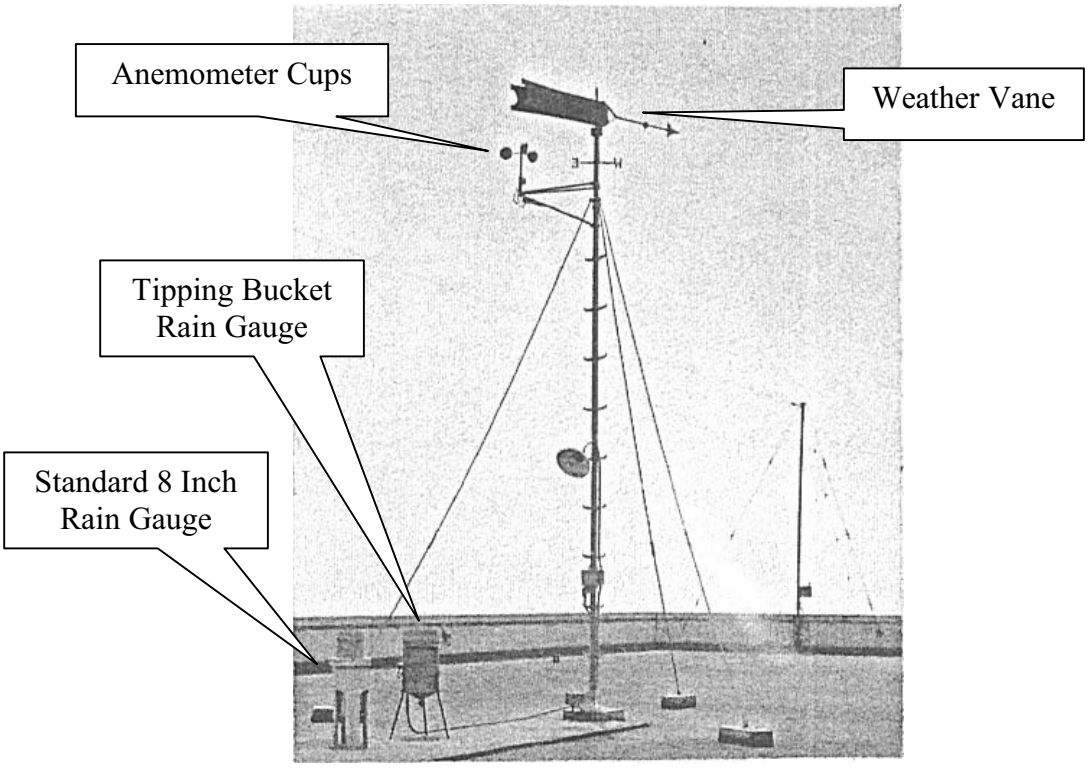


Figure 16. Wind Instruments on Upper Roof of Federal Building, 1951

Source: National Weather Service Forecast Office, Oxnard

Table 7. Anemometers Used at Los Angeles

Number	In Use From	To
*244	1 Jul 1977	6 May 1886
514	6 May 1886	Jun 1887
587	Jun 1887	5 Sep 1889
467	5 Sep 1889	1 Nov 1890
587	1 Nov 1890	?
730	?	15 Jul 1890
467	15 Jul 1890	?
432	?	28 Jun 1904
*496	28 Jun 1904	30 Nov 1905
384	30 Nov 1905	24 Nov 1908
865	24 Nov 1908	?

Rain Gauges

The 1877 instructions from the Report of the Chief Signal Officer for the rain gauge was to be placed so that the funnel-shaped collector was 12 inches above ground level. When a sufficiently clear site could not be found, the gauge was to be mounted away from obstructions on the roof.

Elias Loomis described one rain gauge in use during the period and depicted it in his famous 1868 book, Treatise on Meteorology. He stated that the gauges were usually 10 inches in diameter but that a cylinder 2 inches in diameter was accurate if carefully made. He described the rain gauge as being one used by the Smithsonian Institution, one that was convenient to use and one that produced accurate measurements. The instrument (Figure 17) dimensions were 2 inch diameter of the funnel (AB), ½ inch diameter (CD) inner cylinder

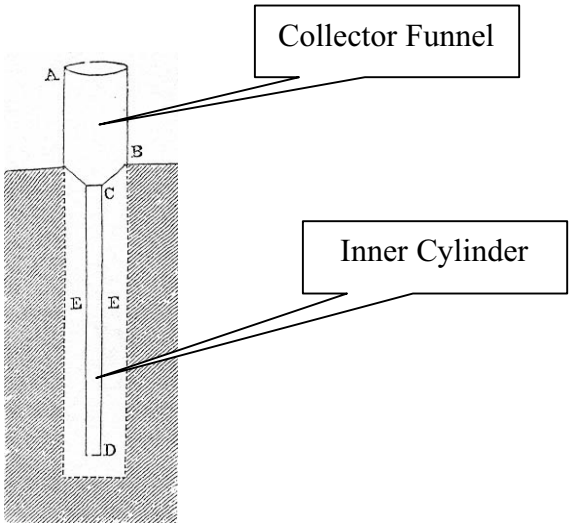


Figure 17. Smithsonian Rain Gauge
Source: Loomis' Treatise on Meteorology, 1868

The Inspector in 1877 suggested that the spare rain gauge be mounted at the surface near the top of the nearby hill. There was no indication that was done.

In 1881, the rain gauge was mounted on the cupola of the Baker Block 107 feet above ground level (AGL).

A snow gauge was in service in 1887 although it would not find a use very often.

The Inspector in 1888 discussed the controversy from the newspaper article presented on page 5 above. He examined the records of rainfall at the Signal Service office and compared them with the year to date observations at the Hotel Raymond five miles east, the Southern Pacific Railway 3/4th mile northeast, and Mr. Ducommun's residence 1/4 mile southeast. Those comparison stations showed from three to six inches greater rainfall than the Signal Service readings. The Inspector said that the present rooftop (Figure 18) would not permit a better exposure, note the many chimneys and ventilators

.

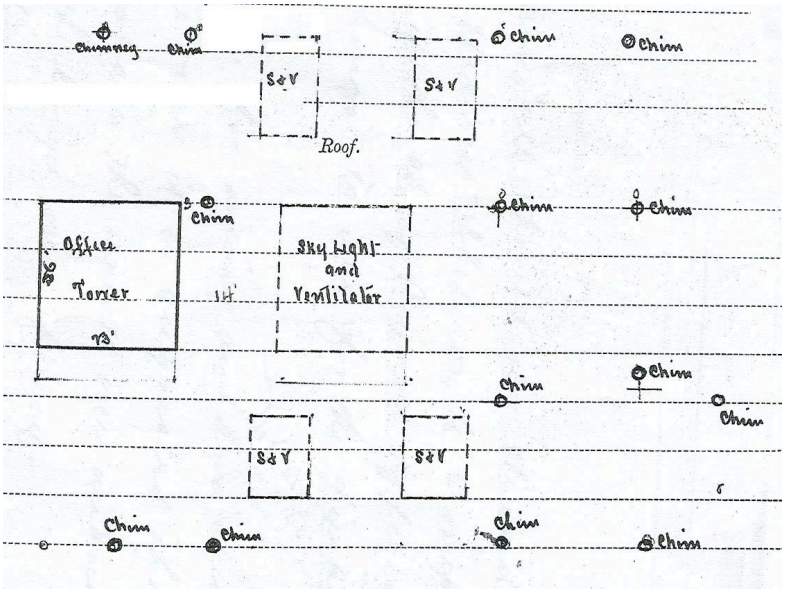


Figure 18. Rooftop in 1888
Source: National Archives and Records Administration

The standard eight-inch rain gauge was mounted at 50 feet AGL beginning on 1 July 1877. It was at 107 feet AGL from 18 January 1881, at 67 feet AGL from 1 November 1888, at 108 feet AGL from 15 October 1902, at 151 feet AGL from 1 August 1908, and at 235 feet AGL after 1 March 1940. The exposures were considered poor during high wind conditions because the roof locations produced a light catch.

A tipping bucket rain gauge was installed on 18 February 1897 and was mounted 67 feet AGL. It was at 108 feet AGL from 15 October 1902, at 151 from 1 august 1908, 235 feet after 1 March 1940. A weighing rain gauge was added on 1 March 1940. The standard and tipping bucket gauges can be seen in Figure 16.

Instrument Shelters

The first Signal Service shelter was mounted in the north-facing window of the office when the first inspection was made in 1878. One would presume that it had not moved since the office opened in July 1877 because the office had not moved. The Inspector drew the shelter that showed the location of the instruments inside (Figure 19).

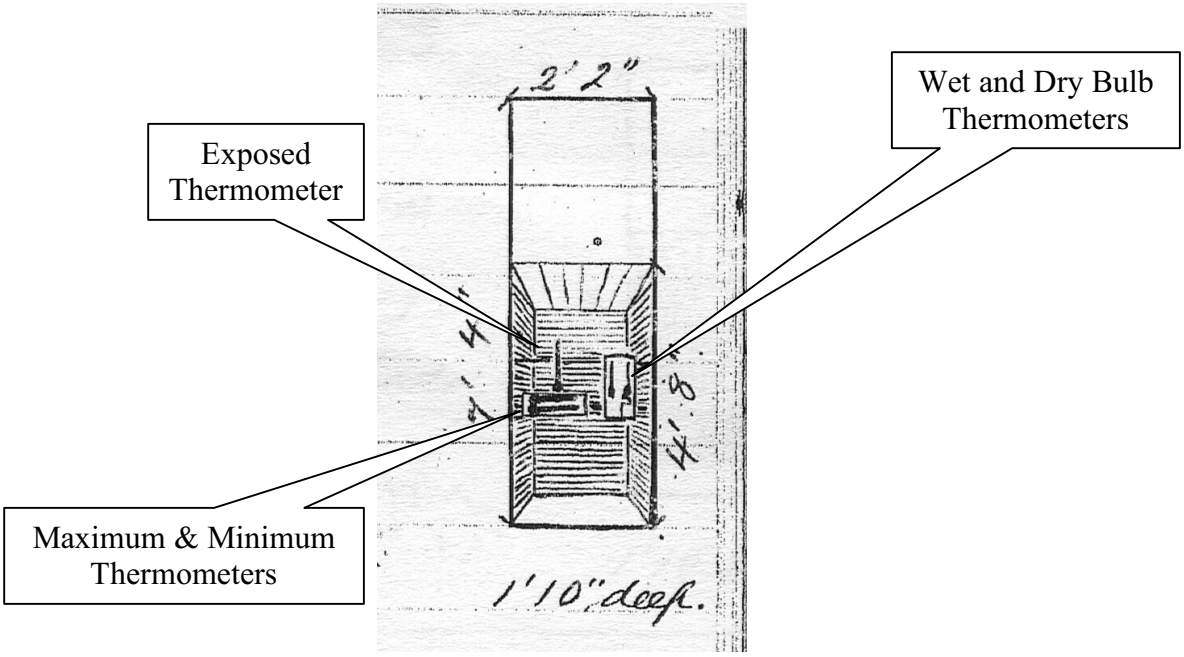


Figure 19. Window Shelter 1878
Source: National Archives and Records Administration

The window shelter, painted a slate color, was in a north-facing window of the Baker Building when the Inspector made the drawing in Figure 20.

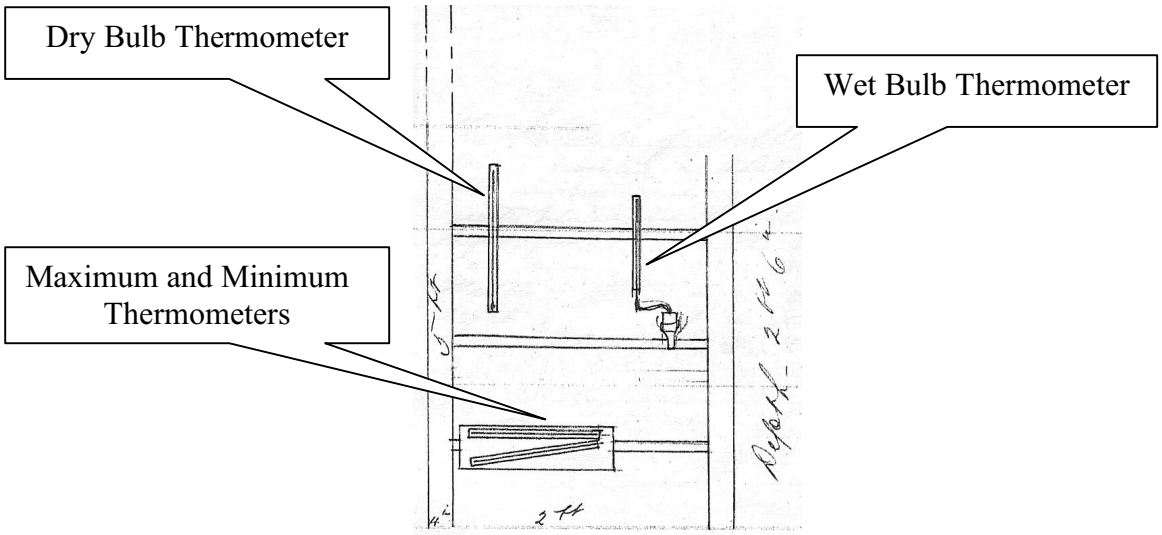


Figure 20. Window Shelter 1882
Source: National Archives and Records Administration

In 1885, the shelter's location, although in a north-facing window was described as less than desirable. About ten feet from one side of it was a wall at the same height as the shelter projecting outward. A tower was about 49 feet from the shelter and a tin painted roof was about 7 feet below it. He wrote, "All them, it would seem, reflect heat to the bulbs, making them read too high."

There were two shelters after March 1940 at the Post Office and Court House Building, called the Federal Building. One was mounted on a lower roof parking area (Figure 21). It is circled on the left photograph and is shown at eye level on the right one. The second shelter was mounted on the upper roof on top of the cupola (Figure 22).

Figure 21. Lower Shelter at Federal Building, 1948

Source: National Weather Service Forecast Office, Oxnard

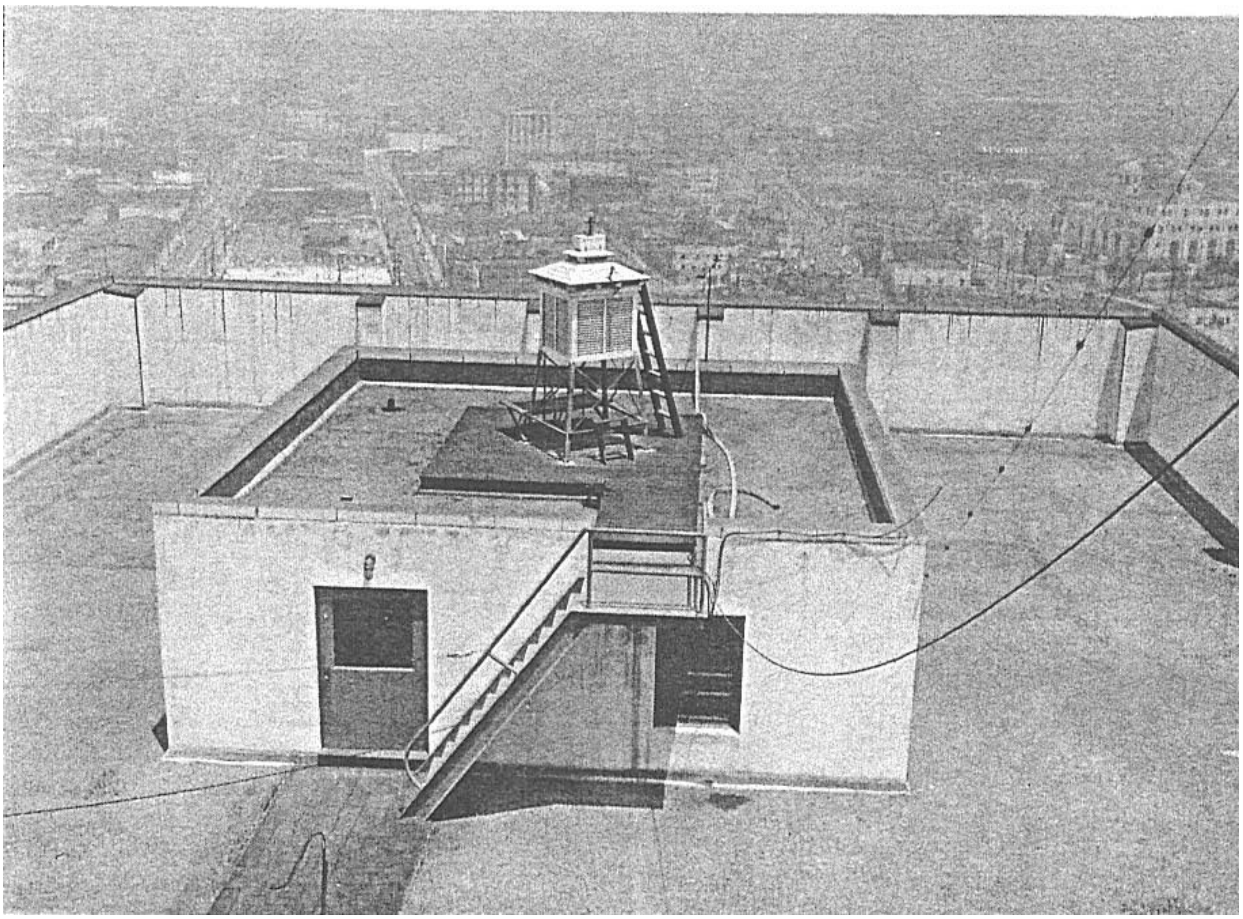


Figure 22. Upper Shelter at Federal Building 1948
Source: National Weather Service Forecast Office, Oxnard

THE OBSERVERS

The weather observers at Los Angeles had many differences but they shared a common interest in weather and climate. The earliest ones were members of the U.S. Army and later ones were members of the Weather Bureau or the National Weather Service. All were dedicated observers of our environment.

Surgeon General Observer

John Strother Griffin, MD

Dr. John S. Griffin (Figure 23) was the first observer in Los Angeles when he made the observations on 1 June 1847. He was born in Virginia, received his medical degree from the University of Pennsylvania, and practiced in Louisville, Kentucky for three years. On 18 June 1840, he was commissioned as an Assistant Surgeon in the U. S. Army.

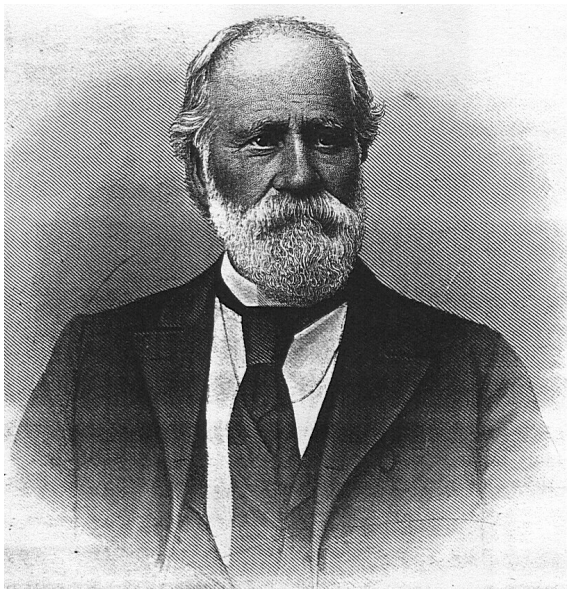


Figure 23. Dr. John S. Griffin, First Weather Observer in Los Angeles, 1847
Source: Warner's Illustrated History of Los Angeles, 1889

When the Mexican War began, Dr. Griffin was assigned as a Captain and Surgeon with General Kearny's First Dragoons in Santa Fe. After about a year there, the unit started their march to California in September 1846. His diary was a fascinating daily account of the demanding march across the desert and the bloody engagement at San Pasqual on 6 December. After other engagements, they arrived in Los Angeles on 10 January 1847. Dr. Griffin was placed in charge of the general hospital in Los Angeles in May 1847. It was in that capacity that he began observations on 5 June.

Dr. Griffin's stay in Los Angeles was relatively short. He continued the weather observations through 21 March 1848 when his unit moved to San Diego.

After fourteen years of service, he resigned from the Army in 1854 in Washington D.C., where he had served with the War Department. In 1848, he had written in his diary, "Taking everything into consideration I think Los Angeles is decidedly one of the most desirable places I have ever been at." He acted on that opinion, moved back to Los Angeles to practice medicine, and become one of its leading citizens.

March 1848 through June 1877

There are no weather records from Los Angeles for the 1849 through 1876 period. Drum Barracks at Wilmington, California recorded weather observations from May 1864 through November 1871. Although Drum Barracks was not close enough to be considered as a continuation of the Los Angeles station (the subsequent Signal Service observation sites were close enough), its records may be useful to climatologists in some studies to fill the gap.

Signal Service Observers

After a 29-year gap, the Army's Signal Service took action that re-established observations in Los Angeles.

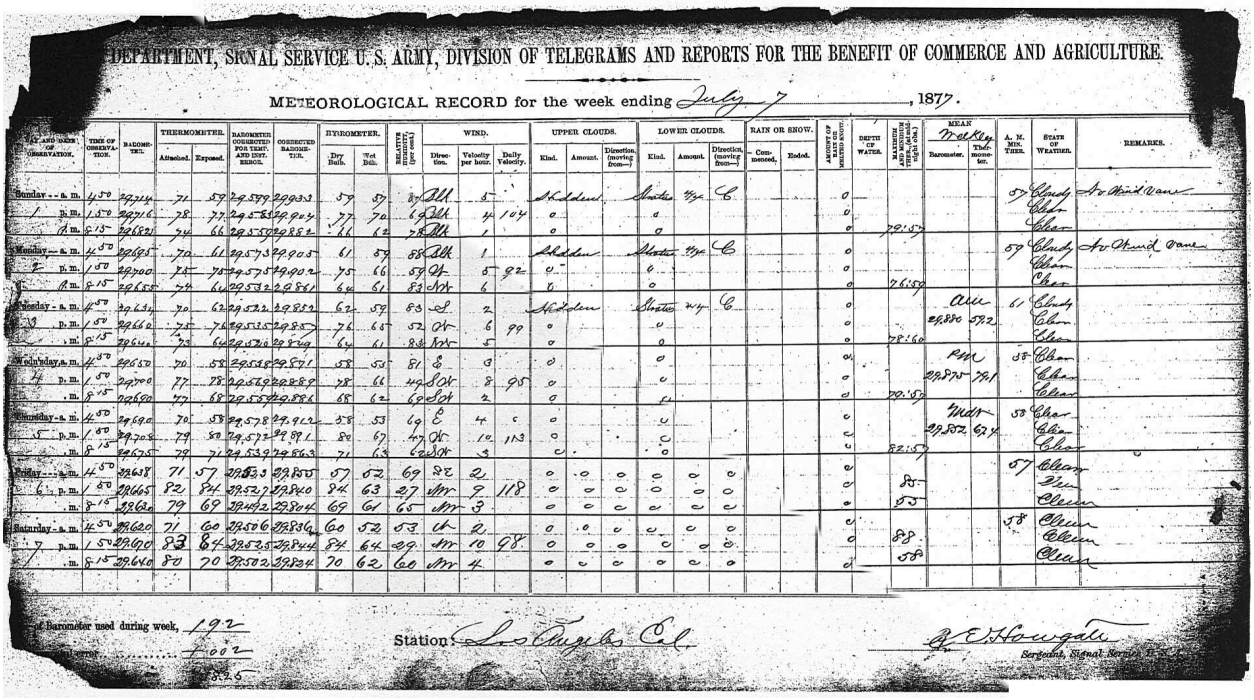
The Signal Service resulted from a resolution passed by Congress on 9 February 1870. The goal was to meteorological observations at the "military stations in the interior of the continent and at other points in the States and Territories." On 1 November 1870, the first weather reports were sent by telegraph to the Signal Service Office in Washington. From those reports, weather maps were produced and probabilities were published. We now call those products forecasts rather then probabilities. On June 10, 1872, an act of Congress extended the forecasting service throughout the United States. Thus began the path that led to the National Weather Service today. Forecasts had been prepared daily for almost seven years when the first Signal Service office opened in Los Angeles.

According to the 1877 report of the Chief Signal Officer of the Army, the Special Order Number 62, dated 21 May 1877, directed Sgt Marion M. Sickler to establish a weather station in Los Angeles to be ready for observations to begin on 1 July 1877. He accomplished that task and was replaced by the first Observer Sergeant assigned to Los Angeles.

Sgt C. E. Howgate

Sgt C. E. Howgate was the first Signal Service Observer Sergeant in Los Angeles and his first observations were made on 1 July 1877, exactly on schedule at the location Sgt Sickler had prepared. He recorded them on a Signal Service form that was forwarded

to Washington at the end of the month. For a local record, he wrote those observations in the Climatological Record Book (Figure 24) kept at the Signal Service Office.



DEPARTMENT, SIGNAL SERVICE U. S. ARMY, DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

METEOROLOGICAL RECORD for the week ending July 7, 1877.

DAY AND HOUR OF OBSERVATION	TIME OF OBSERVATION	BAROMETER.	THERMOMETER. Attached.	THERMOMETER. Exposed.	BAROMETER CORRECTED FOR TEMP. AND INST. ERROR.	CORRECTED BAROMETER.	HYGROMETER. Dry Bulb.	HYGROMETER. Wet Bulb.	RELATIVE HUMIDITY (per cent.)	WIND. Direction.	WIND. Velocity per hour.	WIND. Daily Velocity.	UPPER CLOUDS. Kind.	UPPER CLOUDS. Amount.	UPPER CLOUDS. Direction (moving from—)	LOWER CLOUDS. Kind.	LOWER CLOUDS. Amount.	LOWER CLOUDS. Direction (moving from—)	RAIN OR SNOW. Commenced.	RAIN OR SNOW. Ended.	AMOUNT OF RAIN OR MELTED SNOW.	DEPTH OF WATER.	MAXIMUM VELOCITY AND DIRECTION (for one hour.)	MEAN Barometer.	MEAN Ther. mometer.	A. M. MIN. THER.	STATE OF WEATHER.	REMARKS.
Sunday - - a. m.	4 50	29.714	71	57	29.579	29.933	57	57	57	Alt	8		Shaded			Strato	Wy	C			0					57	Cloudy	Strong Wind Wave
" p. m.	1 50	29.716	78	77	29.582	29.904	77	70	69	Alt	4	104	0			0					0						Clear	
" n. m.	8 15	29.682	74	66	29.550	29.882	66	62	78	Alt	1		0			0					0		20:57				Clear	
Monday - - a. m.	4 50	29.695	70	61	29.575	29.905	61	57	58	Alt	1		Shaded			Strato	Wy	C			0					57	Cloudy	Strong Wind Wave
" p. m.	1 50	29.700	75	75	29.575	29.902	75	66	57	Ot	8	92	0			0					0						Clear	
" n. m.	8 15	29.650	74	64	29.532	29.881	64	61	83	NW	6		0			0					0		26:59				Clear	
Tuesday - a. m.	4 50	29.643	70	62	29.522	29.852	62	57	63	S	2		Shaded			Strato	Wy	C			0			Alto		61	Cloudy	
" p. m.	1 50	29.660	75	74	29.535	29.858	74	65	52	Ot	6	99	0			0					0			29.880	57.2		Clear	
" n. m.	8 15	29.640	73	64	29.526	29.849	64	61	88	NW	5		0			0					0		28:60				Clear	
Wednesday - a. m.	4 50	29.650	70	58	29.538	29.871	58	53	81	S	9		0			0					0			Rain		58	Clear	
" p. m.	1 50	29.700	77	78	29.579	29.889	78	66	49	SW	8	95	0			0					0			29.875	79.1		Clear	
" n. m.	8 15	29.650	77	68	29.557	29.884	68	62	60	SW	2		0			0					0		20:59				Clear	
Thursday - a. m.	4 50	29.690	70	58	29.578	29.912	58	53	69	E	4		0			0					C			Mist		53	Clear	
" p. m.	1 50	29.705	79	80	29.573	29.891	80	67	47	Ot	10	113	0			C					C			29.802	67.4		Clear	
" n. m.	8 15	29.675	79	71	29.539	29.866	71	63	62	SW	3		C			0					C		22:57				Clear	
Friday - - a. m.	4 50	29.668	71	57	29.533	29.855	57	52	69	SE	2		0	0	0	0	0	0			C					57	Clear	
" p. m.	1 50	29.665	82	84	29.527	29.840	84	63	27	NW	9	118	0	0	0	0	0	0			C		28				Clear	
" n. m.	8 15	29.680	79	69	29.542	29.804	69	61	65	NW	3		0	0	0	0	0	0			C		23				Clear	
Saturday - a. m.	4 50	29.620	71	60	29.506	29.836	60	52	53	W	2		0	0	0	0	0	0			C					58	Clear	
" p. m.	1 50	29.690	83	84	29.525	29.844	84	64	29	NW	10	98	0	0	0	0	0	0			C		28				Clear	
" n. m.	8 15	29.640	80	70	29.502	29.834	70	62	60	NW	4		0	0	0	0	0	0			0		28				Clear	

Barometer used during week, 192 / 202

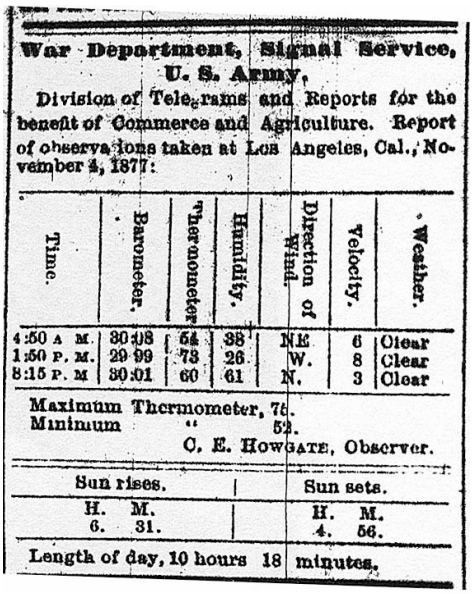
Station: Los Angeles Cal

B. E. Howgate, Sergeant, Signal Service U. S. A.

Figure 24. Station's Record of the First Signal Service Observations in Los Angeles, July 1877

Source: National Weather Service Forecast Office, Oxnard

On 11 October 1877, the Los Angeles Star published his observations for the first time. Thereafter they did so routinely (Figure 25).



War Department, Signal Service, U. S. Army,

Division of Telegrams and Reports for the benefit of Commerce and Agriculture. Report of observations taken at Los Angeles, Cal., November 4, 1877:

Time.	Barometer.	Thermometer	Humidity.	Direction of Wind.	Velocity.	Weather.
4:50 A. M.	30.08	54	38	NE	6	Clear
1:50 P. M.	29.99	73	26	W.	8	Clear
8:15 P. M	30.01	60	61	N.	3	Clear

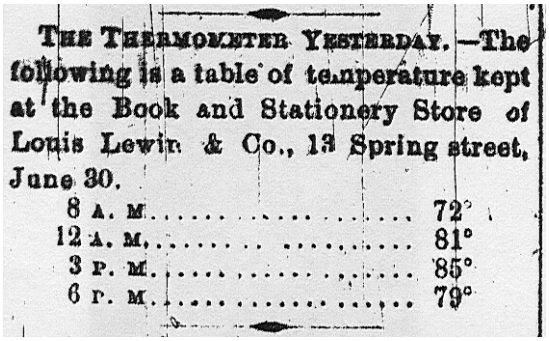
Maximum Thermometer, 76.
Minimum " 52.
C. E. Howgate, Observer.

Sun rises.	Sun sets.
H. M.	H. M.
6. 31.	4. 56.

Length of day, 10 hours 18 minutes.

Figure 25. Sgt Howgate's Observations
Source: Los Angeles Star, 4 November 1877

There had been temperature observations (Figure 26) published occasionally in the Los Angeles Star before Sgt Howgate's arrival that indicated the desire of the public for weather information.



The Thermometer Yesterday.—The following is a table of temperature kept at the Book and Stationery Store of Louis Lewin & Co., 13 Spring street, June 30.

8 A. M..... 72°
12 A. M..... 81°
3 P. M..... 85°
6 P. M..... 79°

Figure 26. Temperature Data from Louis Lewin & Company Book and Stationary Store
Source: Los Angeles Star, 1 July 1877

Sgt Howgate transferred to San Diego where he was the Official in Charge .

Sgt J. M. Frantz

Sgt J. M. Frantz replaced Sgt Howgate on 1 December 1877. He worked without the benefit of an assistant. That meant he had no days off, no vacations, and few hours

each day that did not require his presence. One year later, an Inspection Report noted that he still was without an assistant and that Sgt Frantz had partly instructed his wife in making the observations and would either see that she became competent to the work in the case of necessity or find another young man and instruct him. In the October 1879 inspection, he still had no assistant.

The Signal Service solicited local individuals to form a meteorological committee to identify local needs for weather information. Dr. J. P. Widney was the chairman of the meteorological committee in Los Angeles during this period. He wrote about his interest in climate.

> If we would make our work and our statistics of any true or permanent value, climatic belt must be differentiated from, and contrasted with, climatic belt. It is only thus that our work will lead to a clear understanding of the varied pathological peculiarities of the State.

Dr. Widney would later become the first dean of the USC College of Medicine and USC's second president. Sgt Frantz was fortunate to have had such a great advisor.

Sgt E. F. Kubel

On 24 Mar 1880, Sgt E. F. Kubel assumed the Observer Sergeant position after Sgt Frantz had been transferred to Red Bluff. The next inspection recorded that a civilian assistant for Sgt Kubel, Mr J. G. Decatur, was available for emergencies. Perhaps Sgt. Frantz had been his trainer.

Sgt Egbert van Dyk

Sgt Egbert van Dyk substituted to make the observations during September and October 1882. He was mentioned in a Los Angeles Times article in 1904, “T. S. van Dyke, the well-known authority on irrigation matters, writes … from Duggett, on the Mohave Desert, where he has been developing an irrigation system during the past couple of years.”

Sgt T. S. Collins

Sgt T. S. Collins began observations in November 1882. He continued the provision of data and information releases to the newspapers. He was replaced by Sgt Franklin.

Dec 1884
Sgt George E. Franklin

Sgt George E Franklin became the Observer Sergeant at Los Angeles on 18 December 1884. He was from Annapolis, Maryland and attended St. John's College for sometime. Inspectors described him as a perfect gentleman, well acquainted with modern meteorology and instrumentation. Like the others before him, he contributed data to the newspaper. In November 1886, F. Drinaniak was the substitute observer for one month.

In 1890, Sgt Franklin was age 38, single, and living in the Signal Service Office.

The Weather Bureau Observers 1891-1947

On 1 October 1890, Congress passed an act that transferred the weather service from the Signal Service to the Department of Agriculture effective on 1 July 1891. This was the result of the success of the "probabilities" and the desire to focus those forecasting skills to a practical application rather than a generic and regionally oriented one.

The transition in purpose would take a while. To facilitate the transition, Congress allowed those individuals, who wished to do so, to transfer from the Army to the new Weather Bureau as civilian employees. Those who could retire, were permitted to do so. They then could return to work as civilians in the Weather Bureau in the same facility performing the same job as when they had been doing in the Signal Service.

The Los Angeles Times of 28 April 1891 noted that the military members of the Signal Service had enlisted for five-year terms but would become civilians if they so chose. Sgt George E. Franklin was one of those who made that choice.

Jul 1891
George E. Franklin

The July 1891 report was signed by George E. Franklin but the title Sgt was omitted. As a civilian, he continued to publish and was the author of "Los Angeles" published as a portion of McAdie's Climatology of California in 1903. S. M. Blandfold substituted for Franklin in September and October 1892. Otherwise, Franklin continued service until replaced in 1906.

Mar 1906
Arthur B. Wollaber

Arthur B. Wollaber became the Meteorologist in Charge in March 1906. He was from Buffalo and attended St Joseph's College for some time. He was said to be decidedly above average in executive ability and efficiency.

The office he headed had several workers that he supervised. Observer William D Fuller, assistant observer Oscar D. Stewart, assistant observer E Herbert Thompson, printer William J Carson, and messenger Phillip M Davies were members of his staff.

In 1909, Wollaber, in a new role for the office, directed the development of a snowfall observation network. The rationale was that it was needed for conservation of water and the protection of arable land. The network had two observation goals; to measure snow and rainfall in the mountains and to ascertain evaporation from the water storage lakes and reservoirs. The network was a part of the Weather Bureau's program westward of the Dakotas, Nebraska, Colorado, and New Mexico. Special gauges were installed to measure the depth of the snow on the ground.

1912
Ford Ashman Carpenter, ScD., LL. D., F.R.G.S

Ford Ashman Carpenter signed the Local Climatological Data publication as Meteorologist in Charge at Los Angeles in 1912. He was born in Chicago and had an illustrious career with the Weather Bureau.

He published "Whirlwind of January 26, 1918" and "Alleged Manufacture of Rain in Southern California" in the Monthly Weather Review (see Bibliography). He published a collection of his papers in a book "Weather Methods" ca 1924. It included twenty seven papers published between June 1922 and June 1924 in a variety of publications: Proceedings of Royal Meteorological Society, Southern California Business, Aviation, THE ACE, Proceedings of the American Climatological and Clinical Association, University of California Southern Branch, Bulletin of Southern California Academy of Sciences, California Cultivator, The Players, United States Patent Office, Atlantic Monthly, Los Angeles Herald, Bulletin Los Angeles Consistory, and the Los Angeles Chamber of Commerce.

Carpenter (Figure 27) received an LL.D. from Whittier College in 1913 and was thereafter called "Doctor" by the men in his office and by the press. He received a Sc. D. from Occidental College in 1921.

Figure 27. Ford Ashman Carpenter
Source: Carpenter's Weather Methods

He taught meteorology courses in the Department of Geography in the University of California Southern Branch in 1922-23, was a lecturer in meteorology for the War Department's Air Service, a Manager of the Los Angeles Chamber of Commerce Department of Meteorology and Aeronautics, a Balloon Pilot with the Federation Aeronautique, and a member of the Royal Geographic and Meteorological Societies. He gave many talks to local civic clubs.

He was responsible for installing many rainfall stations in the San Gabriel and San Bernardino ranges. The instruments, many packed in on the backs of horses and mules, were furnished by the Weather Bureau and the costs borne by the counties.

He applied for a patent for a recording instrument to graphically record two or more weather variables.

In 1919, he left the Weather Bureau and became the manager of the department of meteorology and aeronautics for the Los Angeles Chamber of Commerce.

Sep 1919
Lt Col Henry B. Hersey

Born at Williamstown, Vt., on July 28, 1861, Henry B. Hersey enlisted in the Signal Corps on 29 June 1883. After the usual period of instruction in meteorology at Fort Myer, he served as assistant at New London and as official in charge at Deadwood and

Titusville until 28 June 1888. He reenlisted on 28 July 1888, and was assigned in charge at Titusville. Later while in charge at Santa Fe, he was given furlough to enter the Volunteer Army as a Major, 1st U. S. Cavalry during war with Spain. He was restored to duty at Santa Fe on 18 October 1898. Afterward, he served successively in charge at Louisville, Ithaca, Milwaukee, and Los Angeles, being in charge of the latter station from September 1919 until the time of his retirement. While in charge at the Milwaukee station, he was furloughed from 9 April 1917, to 1 July 1919 for service with the U.S. Army in France in World War I. He retired on 30 June 1932.

According to his predecessor Carpenter, he was the executive officer of the Chicago Record-Herald polar expedition that unsuccessfully attempted an airship flight from Spitzbergen to the North Pole in 1907.

July 1932
Col. Lawrence. Hite Daingerfield, PhB

Lawrence Hite Daingerfield was the Senior Meteorologist in Charge in July 1932. His entire career was with the Weather Bureau. He was a native of Missouri. After his graduation from Northwest Missouri College, he entered the Weather Bureau at Arlington, Va., on March 19, 1898 as an aerial observer. He was a pioneer in upper air meteorology and made the first upper air observations in the Pacific Ocean in an Army DeHaviland airplane in 1921. He had been the MIC at Pueblo, Cheyenne, Honolulu, and Houston before coming to Los Angeles.

He published “Southern California Rain and Flood” in the May 1938 issue of the Monthly Weather Review. He published other articles in the Monthly Weather Review, the Geographical Review, and the Annals of the Association of American Geographers both before and after his assignment to Los Angeles.

He was reassigned to New Orleans in November 1941 and retired back to Los Angeles in 1943.
July 1941
Merrill Bernard

Merrill Bernard’s tenure as the Meteorologist in Charge at Los Angeles was brief. He afterward became the Chief of the Climatological and Hydrologic Services Division of the Weather Bureau. He addressed the new punch card technology that allowed numerical data to be represented by holes in a card and then read by a punch card reader. For the first time, large data sets could be summarized and used for calculations. However, words such as station names presented problems. Bernard made a lasting contribution by the development of a system to identify stations using numbers in addition to their names.

The assigned numbers had six digits, the first two of which identified the state (01 for Alabama, 04 for California, 48 for Wyoming, and 49 for the District of Columbia). In September 1948, two digit numbers were assigned to "extra continental" (sic) stations (50

for Alaska and 51 for Hawaii). At the same time, two digit identifiers were assigned for other North American and Caribbean countries. They were anticipating that a more global role would evolve.

The last four numbers of the station number identified the specific station. The original numbers were assigned according to the station's relative position on the "Index of Cities and Towns" published in the 65th edition of the Rand-McNally Atlas. The example they used was that station number 1734 was about 1734/9900 of the distance between the first and last names in that state's index. A minimum of five numbers separated stations within the same city and a minimum of eight numbers separated stations adjacent of the index. If a station moved significantly, a new station number would be used and the old number would not be reused for any other location. The old number was used if the old site was reestablished.

The digital climatological record continues to use Bernard's system. For example, Los Angeles WSO Airport was identified by the number 045114 and the Los Angeles Civic Center, the name given later to the lineage in this current study, was assigned the number 045115.

May 1942 – Jun 1952
Harry W. Douglas

Harry W. Douglas was the Meteorologist in Charge beginning in May 1942. He was a native of Illinois. In the 1930 census, he was located in Juneau, Alaska as an Assistant Meteorologist with the Weather Bureau.

THE OBSERVATIONS

The Surgeon General Years

The first observations in June 1847 were taken by Dr. Griffin (Figure 1) and entered on the Surgeon General's Form 3, Meteorological Register. Two conclusions can be drawn. It is probable that he had brought the Surgeon General's Observation Forms with him on the long arduous trip from Santa Fe. Second, he had brought a thermometer with him too. On that first submission, he recorded the temperature, the clearness of the sky, and the winds at sunrise, 9 a.m., 3 p.m., and 9 p.m. He recorded the beginning and ending times of the rain event that occurred during the next month. He apparently did not have a rain gauge because he did not record amounts of rainfall.

The observations ended with the March 1848 observations after the Army moved from El Pueblo de Los Angeles to San Diego.

The Gap in the Record

When the Army moved away, there was no one to assume the observer role in an official capacity. Later in the twenty-nine year gap, some temperature measurements were made in the downtown area. A few of those were published in the newspaper but none of those original records are known to exist.

The Signal Service Years

Observations began anew in July 1877 when the Signal Service arrived. The form used by the Signal Service at that time was the War Department Form E. The new station at Los Angeles had the observational equipment necessary to fill in all the columns. That form contained the first barometer readings ever reported from Los Angeles. The barometer, thermometer, and rainfall data were entered at a.m., p.m., and midnight. The maximum and minimum temperature for the day was reported with the prevailing wind direction and the maximum hourly velocity of the wind. The number of times the wind was from the cardinal points was entered.

At the bottom left of the form was a climatological summary of the month with twenty statistics indicating means, extremes, and numerical summaries.

At the bottom right of the form was an accounting of the precipitation during the month, including the time the rainfall events began and ended. The form (Figure 28) was an impressive collection of data considering that only one person (Sgt Howgate) made all the observations and all the entries.

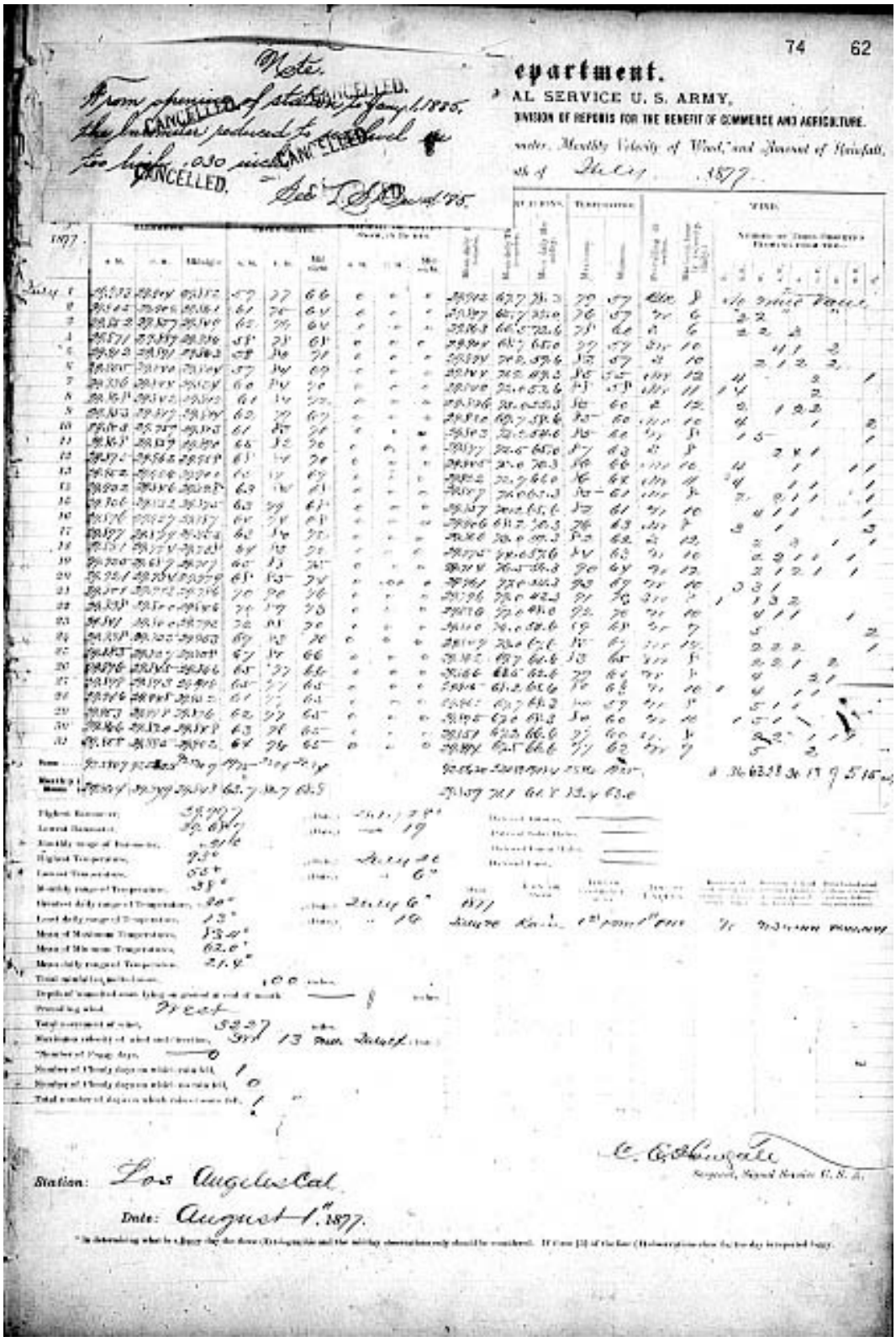


Figure 28. Sgt. Howgates First Observations from Los Angeles in July 1877
Source: National Climatic Data Center

Time of Observations

For the period prior to the use of "standard time," the term "local time" referred to solar time. The Signal Service's director, Cleveland Abbe, in 1875 was one of the government agencies that advocated the establishment of standard time zones. It was needed to facilitate the plotting of weather maps containing data collected at the same moment. All times before 1883 were based on solar noon, when the sun was at its zenith for a given longitude. Instructions for observations to be made at 7 a.m., for example, would vary up to four hours depending on the longitude of the observer. The standard time zones came into use by the railroads in November 1883 and by the Signal Service shortly there after.

The Chief Signal Officer (Cleveland Abbe) tried to make observations at a single moment in time. He requested in 1875 that, wherever practicable, observers make their observations correspond in local time with those taken at the regular signal service stations: at 7:35 a.m., 4:35 p. m., and 11 p. m., Washington mean time. If it were found impracticable to take all of the observations at these hours, it was suggested that, in that case, the 7:35 a.m. (Washington time) be used. Otherwise, the observations were to be taken at 7 a.m., 2 p.m., and 9 p.m., local time. For stations west of Washington the local time of former is slower (that is earlier) than the local time of latter by (4) four minutes for every degree of longitude—for stations east of Washington it is faster, (that is later). When, it is 7:35 a. m. at Washington, at places ten degrees (10˚) to the westward it is 5:55 a.m.; at places thirty-five and one-half degrees (35.5°) to the westward it is 5:13 a.m.; at places forty-seven and three-quarters degrees (47.75°) to the westward it is 4:24 a.m., etc. In entering the time of observation, the local time of the station was to be given.

The time of observation was changed and, in 1879, required the observer to make observations at 7 a.m., 2 p.m., and 9 p.m. local time in addition to the 7 a.m., 3 p.m., and 11 p.m. Washington time. All of which required the observer to make observations at 4:15 a.m., 7:00 a.m., 12:15 a.m., 2:00 p.m., 8:15 p.m., and 9:00 p.m. That he accomplished without an assistant for several years in Los Angeles.

The 1884 Annual Report of the Chief Signal officer described how the problem was reconciled.

> At first the number of station and the area covered by the predictions were limited. But, when once the fact had been established that at any hour of the day or night, the central office could almost instantly call for report from all parts of the country, and receive them from all its stations, taken at the same moment of time, and revealing the actual status of the atmosphere over its whole field of inquiry, the sense of security in its scientific processes, and the confidence that the results were build upon "the solid ground of nature," gave it a powerful forward impulse. The method of simultaneous reports, it was felt, was a sure road to the

desired goal.

Services Provided

In his Annual Report made in June 1879 for the previous year, Observer Sergeant Frantz, commented on his activities.

> The interest in the service continues, and is steadily on the increase, as is shown by the willingness of the press to publish all reports tendered them. This office is visited by all classes of citizens, and is considered authority on all subjects pertaining to the weather. The newspapers printing the monthly abstracts of Form 22 are preserved by some professional men and others interested in meteorological data for future reference. Frequent inquiries are made for reports of rain-fall extending back over a great number of years. On two occasions I was subpœnaed before courts of law with the office records.
>
> Efforts have been made to extend the circulation of the weather reports of this office among the different nationalities, which it is believed will prove successful. Editors of German, Spanish, and French newspapers have expressed themselves as willing to publish abstracts of monthly means similar to those now being published, commencing with the new year.

He wrote that the office had provided 1,871 bulletins, 891 local reports, and 32 Form 22 for the year ending 30 June 1879. All that, it must be noted, he accomplished without an assistant.

The Annual Report of the following year reported that services provided were almost identical in number. The Chamber of Commerce visited, examined the instruments, and reportedly took great interest in what they saw. Other visitors were becoming more numerous and they too were anxious to see the instruments and to hear of their uses. Health seekers were also visiting the office requesting information about temperature, moisture, winds, rainfall, and other weather elements.

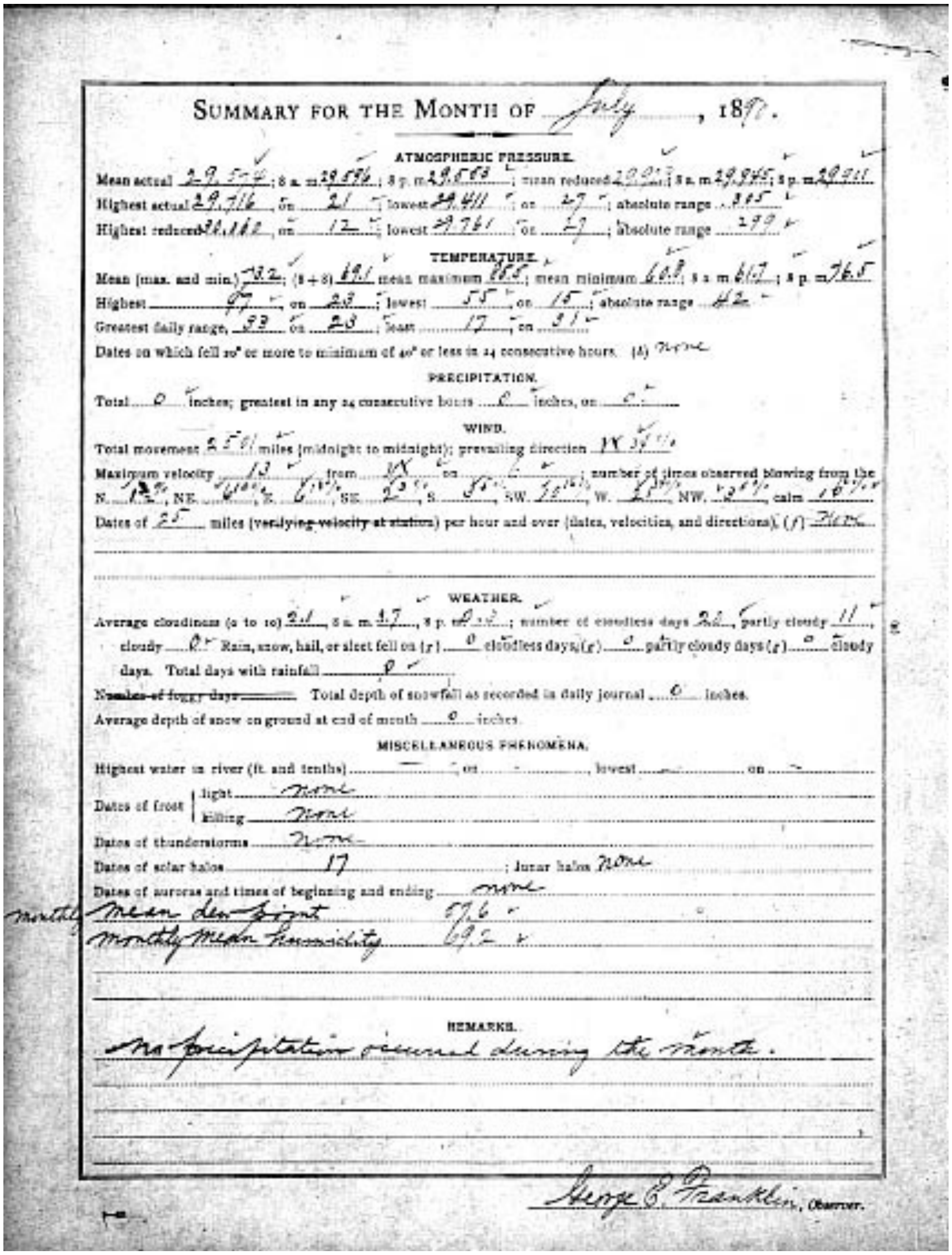
The 1881 Annual Report reported another group that was very interested in what the office had to offer.

> Vine-culturists and fruit-growers continue to give the publications of this office their careful attention, and it is for these interests that the work of this office has its greatest local value.

The number of publications had increased to 2,382 bulletins, 961 local reports, and 30 Form 32.

The Weather Bureau Years

On 1 July 1891, the Weather Bureau took over the observations. That month the reporting form was six pages of data covering the full gamut weather instrumentation. The office was staffed to accomplish these observations and the observers were now civilians. The last page of the six-page report (Figure 29) was signed by one of the new civilians, George E. Franklin.



SUMMARY FOR THE MONTH OF July, 1891.

ATMOSPHERIC PRESSURE.

Mean actual 29.574; 8 a. m. 29.596; 8 p. m. 29.563; mean reduced [illegible]; 8 a. m. 29.945; 8 p. m. 29.911
Highest actual 29.716, on 21; lowest 29.411; on 27; absolute range .305
Highest reduced 30.060, on 12; lowest 29.761; on 27; absolute range .299

TEMPERATURE.

Mean (max. and min.) 73.2; (8+8) 69.1 mean maximum 85.5; mean minimum 60.8; 8 a. m. 61.7; 8 p. m. 76.5
Highest 97, on 23; lowest 55, on 15; absolute range 42
Greatest daily range, 33 on 23; least 17, on 31
Dates on which fell 20° or more to minimum of 40° or less in 24 consecutive hours. (h) None

PRECIPITATION.

Total 0 inches; greatest in any 24 consecutive hours 0 inches, on 0

WIND.

Total movement 2501 miles (midnight to midnight); prevailing direction W 34%
Maximum velocity 13 from W on 2; number of times observed blowing from the N. 12%, NE. 6%, E. 6%, SE. 2%, S. 5%, SW. 15%, W. 23%, NW. 13%, calm 16%
Dates of 25 miles (~~verifying velocity at station~~) per hour and over (dates, velocities, and directions). (f) None

WEATHER.

Average cloudiness (0 to 10) 2.1, 8 a. m. 1.7, 8 p. m. [illegible]; number of cloudless days 20, partly cloudy 11, cloudy 0. Rain, snow, hail, or sleet fell on (g) 0 cloudless days, (g) 0 partly cloudy days (g) 0 cloudy days. Total days with rainfall 0
~~Number of foggy days~~ Total depth of snowfall as recorded in daily journal 0 inches.
Average depth of snow on ground at end of month 0 inches.

MISCELLANEOUS PHENOMENA.

Highest water in river (ft. and tenths) —, on —, lowest —, on —
Dates of frost: light none; killing none
Dates of thunderstorms None
Dates of solar halos 17; lunar halos none
Dates of auroras and times of beginning and ending none
monthly mean dew point 57.6
monthly mean humidity 69.2

REMARKS.

No precipitation occurred during the month.

George E. Franklin, Observer.

Figure 29. Page Six, First Weather Bureau Report from Los Angeles, July 1891
Source: National Climatic Data Center

In June 1885, the Los Angeles Weather Bureau Office began displaying signal flags on the flagstaff of the Wilson Building. These were forecast flags to broadcast, so to speak, the current forecast. The Los Angeles Times of 2 June 1885 presented the new forecast system to the public in an extensive article describing how to interpret the flags.

The forecast flags were to be displayed prominently so that citizens could see what weather conditions were forecast for that location. The use of the flags began shortly after

the Weather Bureau took over from the Signal Service. Two versions of the flags were used. One displayed the precipitation forecast, the other temperature.

Square flags (Figure 30) gave the precipitation forecasts; white for fair, blue for rain or snow, and half white—half blue for showers. A pennant gave the temperature forecast by its position on the staff: warmer if above the precipitation flag, colder if below, and no change if it wasn't displayed. A square white flag with a small black square in its center forecast a cold wave.

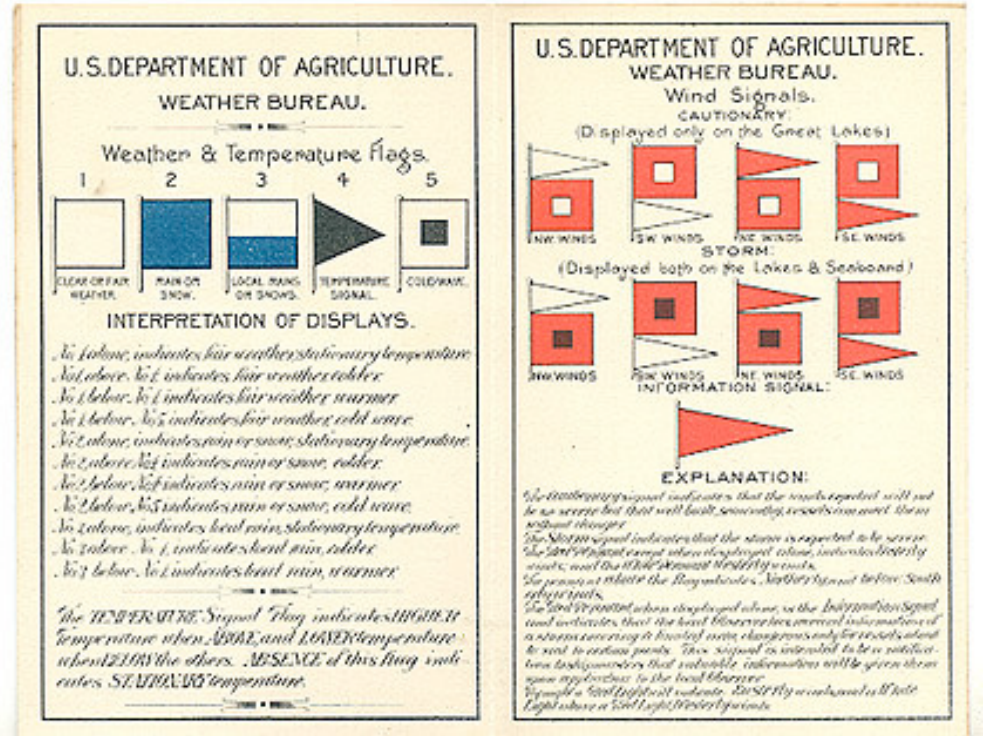


Figure 30. Weather and Temperature Forecast Flags
Source: World's Columbian Exposition Souvenir, 1893

The Weather Bureau issued Station Regulations in 1905. Those rules among other things prohibited smoking in the Forecast Offices. Some of the rules concerned relations with the press.

> The press will be given special consideration in view of the wide distribution afforded by this means. Efforts should be made to furnish matter in such form and at such times as will best conform to the wishes of the managers of the newspapers, and at the same time subserve public interests.

Other rules concerned the observation and reporting of the weather, in particular the barometer.

> Employees are required to use the utmost care to avoid errors in reading, reducing, and enciphering the barometer. An employee who makes two such errors within a period of six months will be admonished, and an employee who is responsible for three such errors within a like period will be subject to disciplinary action.

When the Weather Bureau Office moved from the Central Building to the Federal Building on 29 February 1940, a recording rain gauge was installed and maintained at the old location. It was called "Los Angeles 6th and Main Sts." That site continued to report data for about eleven years. It was discontinued on 30 June 1953.

The Weather Bureau City Office

In 1940, the Weather Bureau opened a second office at the airport. That required the old office downtown to be renamed to distinguish the two. It was thereafter call the Weather Bureau City Office. It would later be known as the Civic Center.

A Memorandum from the Director, NWRC, dated 6 August 1964, announced the demise of the Weather Bureau Office, Los Angeles.

> Effective July 1, 1964, Weather Bureau Office, Los Angeles was closed and its functions transferred to WBAS, Los Angeles. As indicated in remarks on the attached WB-733-1A for Los Angeles, California (Civic Center) the data from the Civic Center area are now either remoted to the Airport for entry or are recorded and/or observed at the Los Angeles County Air Pollution Control District Headquarters, (434 S. San Pedro Street). Temperature, humidity, and precipitation are remoted from 410 Ducommun Street. Wind, sunshine, sky cover, and solar radiation are observed at the Air Pollution Control District. Because of a cut in personnel it is no longer possible to publish hourly temperature or six-hourly complete humidity data for the Civic Center location.

By that action, the move from downtown to the International Airport begun years earlier was complete. On a Weather Bureau Form 500-1, 13 July 1964, the Los Angeles Civic Center was designated as the name for those downtown observation sites.

Throughout the years, the observations in Los Angeles were a consistent continual record of dependable quality. Although urban warming influenced the data, those data nonetheless reflected the actual temperatures that occurred and will permit climatologists to assess that influence. It thus became one of the important records of the urban heat island phenomenon.

The Digital Record

The digital data for the Los Angeles station whose history is contained in this document has always had the station number 045115. The data from that station is available from the National Climatic Data Center at Asheville NC.

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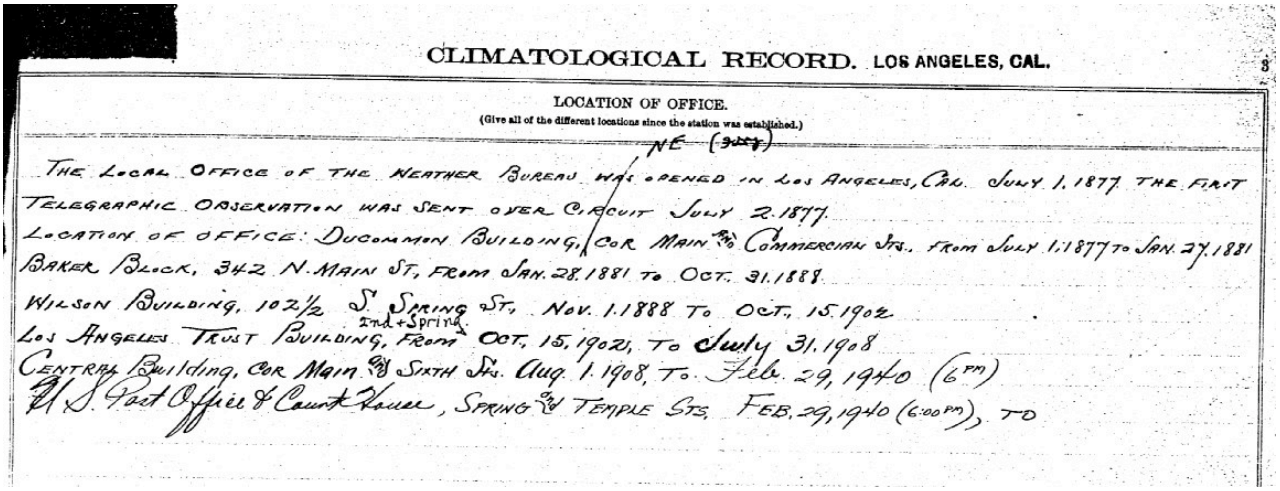
APPENDIX 1

Location of Office
Los Angeles Climatological Record Book



CLIMATOLOGICAL RECORD. LOS ANGELES, CAL.

LOCATION OF OFFICE.
(Give all of the different locations since the station was established.)

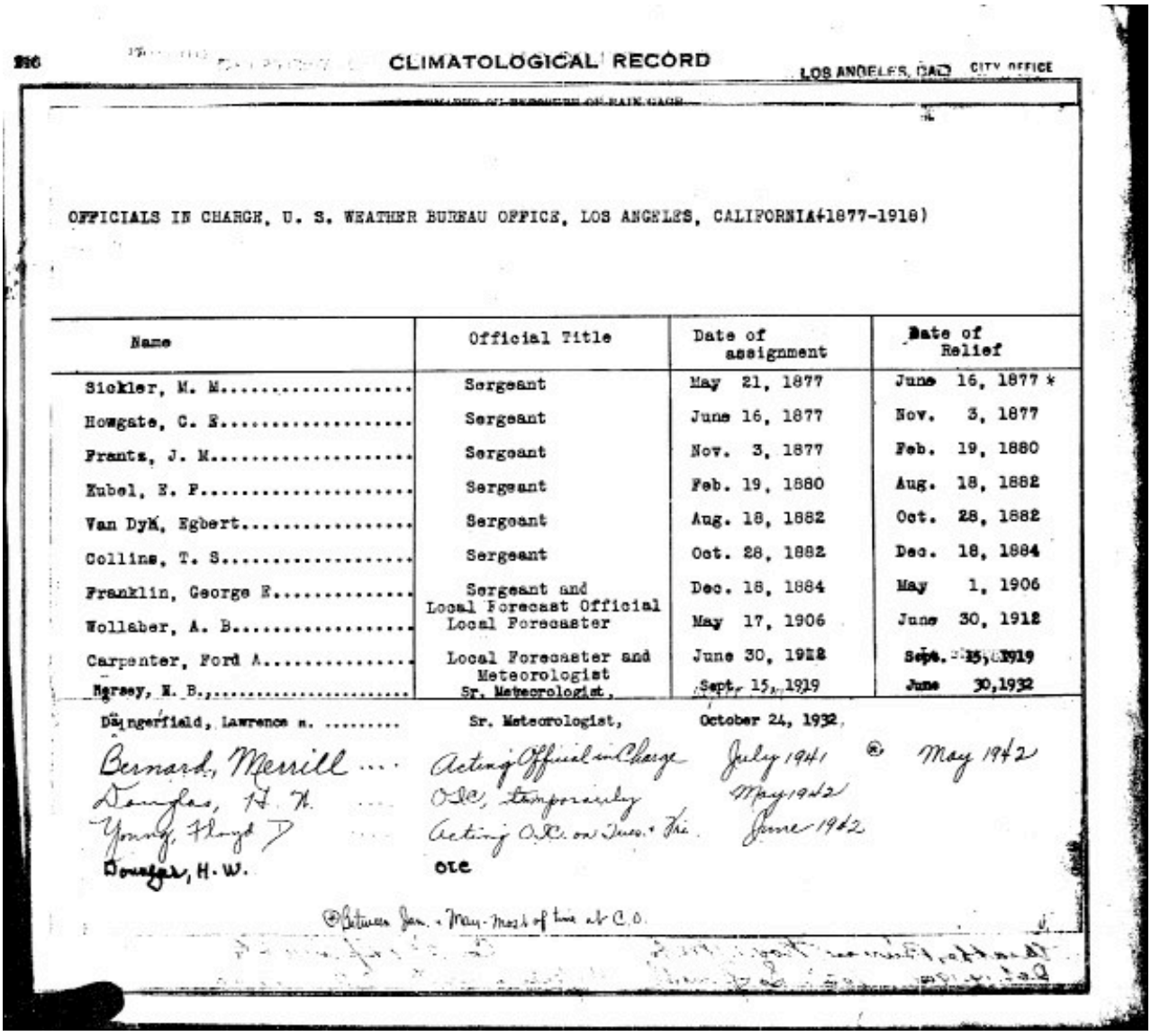
NE (3rd)

THE LOCAL OFFICE OF THE WEATHER BUREAU WAS OPENED IN LOS ANGELES, CAL. JULY 1, 1877 THE FIRST TELEGRAPHIC OBSERVATION WAS SENT OVER CIRCUIT JULY 2. 1877.
LOCATION OF OFFICE: DUCOMMON BUILDING, COR MAIN & COMMERCIAN STS., FROM JULY 1, 1877 TO JAN. 27, 1881
BAKER BLOCK, 342 N. MAIN ST, FROM JAN. 28. 1881 TO OCT. 31. 1888.
WILSON BUILDING, 102½ S. SPRING ST, NOV. 1. 1888 TO OCT., 15. 1902.
LOS ANGELES TRUST BUILDING, FROM 2nd & Spring OCT. 15, 1902, TO July 31. 1908
CENTRAL Building, COR Main & SIXTH Sts. Aug. 1. 1908, TO Feb. 29, 1940 (6 PM)
U.S. Post Office & Court House, SPRING & TEMPLE STS. FEB. 29, 1940 (6:00 PM), TO

Source: National Weather Service Forecast Office, Oxnard

APPENDIX 2

Officials in Charge
Los Angeles 1877-1943



816 CLIMATOLOGICAL RECORD LOS ANGELES, CAL. CITY OFFICE

OFFICIALS IN CHARGE, U. S. WEATHER BUREAU OFFICE, LOS ANGELES, CALIFORNIA(1877-1919)

Name	Official Title	Date of assignment	Date of Relief
Sickler, M. M.	Sergeant	May 21, 1877	June 16, 1877 *
Howgate, C. E.	Sergeant	June 16, 1877	Nov. 3, 1877
Frantz, J. M.	Sergeant	Nov. 3, 1877	Feb. 19, 1880
Kubel, E. F.	Sergeant	Feb. 19, 1880	Aug. 18, 1882
Van Dyk, Egbert	Sergeant	Aug. 18, 1882	Oct. 28, 1882
Collins, T. S.	Sergeant	Oct. 28, 1882	Dec. 18, 1884
Franklin, George E.	Sergeant and Local Forecast Official	Dec. 18, 1884	May 1, 1906
Wollaber, A. B.	Local Forecaster	May 17, 1906	June 30, 1912
Carpenter, Ford A.	Local Forecaster and Meteorologist	June 30, 1912	Sept. 15, 1919
Marsey, H. B.	Sr. Meteorologist,	Sept. 15, 1919	June 30, 1932
Dingerfield, Lawrence H.	Sr. Meteorologist,	October 24, 1932	
Bernard, Merrill	Acting Official in Charge	July 1941 @	May 1942
Douglas, H. W.	OIC, temporarily	May 1942	
Young, Floyd D	Acting OIC on June 1st	June 1942	
Douglas, H. W.	OIC		

@ Between Jan. & May - Much of time at C.O.

Source: National Weather Service Forecast Office, Oxnard

APPENDIX 2

Los Angeles Officials in Charge
Period of Record

Los Angeles – Downtown			Los Angeles - Airport		
Name	In	Out	Name	In	Out
[2]Griffin, John S.	6/1847	3/1848			
[3]Sickler, Marion M.	5/1877	6/1877			
[4]Howgate, C.E.	6/1877	11/1877			
Frantz, John H.	11/1877	2/1880			
Kubel, Edward F.	2/1880	8/1882			
VanDyk, Egbert	8/1882	10/1882			
Collins, Thomas S.	10/1882	12/1884			
[5]Franklin, George E.	12/1884	5/1906			
Wollaber, Arthur B.	5/1906	6/1912			
Carpenter, Ford A.	6/1912	9/1919			
Hersey, Henry B.	9/1919	6/1932			
Daingerfield, Lawrence H.	10/1932	7/1941	[6]Fletcher, Bob	1940	1949
Bernard, Merrill	7/1941	5/1942	[7]Showalter A.K.	1949	1951
Douglas, Harry W.	5/1942	5/1942	Kalstrom,,George	1951	1953
Young, Floyd D.	6/1942	6/1942	Thompson, Jack	1953	1955
Douglas, Harry W.	6/1942	6/1952	[8]Kalstrom, George	1955	1972
			Vederman, Joe	1972	1975
			Reese, Robert	1975	1976
			Lessard, Arthur	1976	1992
			[9]McDuffie, Jerry	1992	1994
			Morris, Todd	1994	2003
			Keeton, Dan	2003	2005
			Jackson, Mark	2005	

Source: Todd Morris, National Weather Service Forecast Office, Oxnard, 2006

[2] Surgeon, U.S. Army, First Official Weather Observer, located at El Pueblo de Los Angeles
[3] Sergeant, U.S. Army Signal Service, Sited and Prepared First Signal Service Office
[4] Sergeant, U.S. Army Signal Service, First Signal Service Observer in Los Angeles
[5] First Weather Bureau Observer and Its First Official in Charge in Los Angeles
[6] First Meteorologist in Charge, Forecast Office Located at Burbank Airport
[7] First Meteorologist in Charge, Weather Bureau Forecast Office Located at Los Angeles Airport
[8] First National Weather Service Meteorologist in Charge in Los Angeles
[9] First National Weather Service Meteorologist in Charge in Oxnard

APPENDIX 4

Methodology

The primary sources of information for this study were the Los Angeles observers' daily weather records themselves. Copies of their monthly reports and the data digitized from those reports were available from the Western Regional Climate Center in Reno, Nevada, or the National Climatic Data Center in Asheville, North Carolina. The monthly reports can be considered original sources because they were written by the observers and not altered by subsequent readers.

There were a variety of secondary sources that held information about Los Angeles, its history, and its people. The author visited and collected information from the holdings of the National Climatic Data Center at Asheville, North Carolina; California State Library and California State Archives in Sacramento, California; Sacramento Public Library; the Library at the California Military Museum in Sacramento, California; the National Weather Service Forecast Office in Oxnard, California; the Los Angeles Public Library; the National Archives and Records Administration in College Park, Maryland; the Smithsonian Institution Archives in Washington D.C.; and the Western Kentucky University Library, in Bowling Green Kentucky.

The tertiary sources were reference materials that are available on-line. Among those were the metadata prepared by the National Weather Service Office in Los Angeles, the Western Regional Climate Center in Reno, Nevada, and the National Climatic Data Center in Asheville, North Carolina. In addition, substation histories previously prepared were consulted. Two genealogical research sources, Ancestry.com and Genealogy.com, were used to provide some of the personal information about the observers. For location analysis, the interactive maps available from TopoZone.com were used.

There was an attempt to glean information from all these sources that would allow a glimpse into the lives of the observers, the location of the observation site, and the historical environment that produced the climatic history of the Los Angeles. Maps, drawings, and photographs were included when appropriate to illustrate the information.

Throughout the research for and preparation of this study, the objective was to produce a document that future studies can use to evaluate the validity of the data that were collected at Los Angeles, judge the trustworthiness of the observers who collected them, and determine the climatological significance of the whatever variability may be discerned.